

Moose Management Report

of survey-inventory activities
1 July 1999–30 June 2001

Carole Healy, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation
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ADF&G

Please note that population and harvest data in this report are estimates and may be refined at a later date.

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SPECIES
MANAGEMENT REPORT

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: Unit 6 (10,140 mi²)

GEOGRAPHIC DESCRIPTION: Prince William Sound and North Gulf Coast

BACKGROUND

Moose populations in most of Unit 6 originated from translocations of calves from the Kenai Peninsula, Anchorage, and Matanuska-Susitna Valley (Burris & McKnight 1973). During 1949–1958, Cordova residents successfully raised 24 captive moose calves and released them on the western Copper River Delta in Unit 6C. This small population rapidly extended eastward, first into Unit 6B and then advancing by the late 1960s into the Bering River area in Unit 6A. Moose may also have reached Unit 6A through dispersal westward from the Malaspina Glacier forelands in Unit 5A. The introduced population reached a record high of approximately 1600 in 1988 (Griese 1990), then declined to about 1227 by 1994 as part of a planned reduction (Nowlin 1998). The only moose endemic to Unit 6 are small populations in the Lowe River drainage and Kings Bay in Unit 6D. These populations never grew and today include only about 40 animals. Harvest of the introduced population began with 25 bulls in 1960. Hunters have taken a total of 3798 moose through 1998–99. In contrast, total harvest of the endemic moose population in Unit 6D during the same period was approximately 40 moose.

Population objectives were relatively conservative in the 1970s and early 1980s because of concern about mortality during severe winters. Objectives were established at 0.9–1.2 moose/mi² after a severe winter in 1971–72, and remained conservative under management plans written in 1976 (Rausch 1977). In 1994, Nowlin (1995) revised objectives using new information about carrying capacity of the winter ranges (MacCracken 1992) and refined estimates of population size.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

Our primary and secondary management goals in Unit 6A (East) are to take large moose and to provide for optimum harvest. Primary and secondary goals for the remainder of Unit 6 are to provide for optimum harvest and to provide for the greatest opportunity to participate in hunting.

POSTHUNT MANAGEMENT OBJECTIVES

Our management objective for Unit 6A (East) is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 30:100. Our objective for Units 6A (West) and 6B is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 15:100 in each unit. In Unit 6C our objective is to increase the population to 400 moose by the year 2006 and maintain a minimum bull:cow ratio of 15:100.

METHODS

We conducted modified (Gasaway et al. 1986) censuses to estimate moose population size and composition. We used Piper Super Cub (PA-18) and Bellanca Scout aircraft for searches of sample units. Estimates of sex and age ratio were only derived from censuses conducted before mid-December. Population estimates were not corrected for sightability. Corrections calculated during previous censuses indicated we observed >89% of the moose present (Nowlin 1998).

Sample units for aerial censuses cover all moose habitat in Units 6A–6C. Viereck et al. (1986) described the habitat types present, and MacCracken (1992) identified types that were most important for moose. These habitat types were below 500 ft elevation in river valleys and deltas of the coastal plain and included open tall-willow (*Salix sp.*), closed tall alder-willow (*Alnus sinuata-Salix sp.*), low sweetgale-willow (*Myrica gale-Salix sp.*), woodland spruce (*Picea sitkensis*) and aquatic (wet forb-herbaceous) (Nowlin 1995).

Hunters participating in drawing or registration permit hunts were required to report. Those that fail to report were telephoned and sent no more than 2 reminder letters. Hunters participating in general moose hunts were sent a reminder letter if they failed to return their hunt report.

We summarized census and harvest data by unit, except for Unit 6A, which was divided into eastern and western portions. The eastern portion was all drainages into the Gulf of Alaska between Cape Suckling and the head of Icy Bay. The western portion was all drainages into the Gulf between Cape Suckling and Palm Point.

In 2000 we began a cooperative study funded by the U.S Forest Service's Cordova Ranger District to monitor moose habitat of the western Copper River Delta (CRD) in Unit 6C. Moose habitat on the CRD is dynamic, with some areas entering into unproductive seral stages and others supporting new growth. Hence, rather than trying to measure carrying capacity based on habitat, we examined nutritional status of moose based on rump fat thickness, which had a strong linear relationship ($r^2=0.96$, $p=0.0001$) with total body fat of pen-reared moose (Stephenson et al. 1998). A total of 12 cows were captured (half with calves) and collared during November and again in March. Rump fat thickness was measured using ultrasonography.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

We conducted censuses in Units 6A West and 6B in November 1999 and 6C in February 2001. No estimates of bull:cow ratios were obtained because many bulls had shed antlers when we conducted the censuses. We could not complete a census in Units 6A East because of continually stormy weather, although we did conduct a short survey to determine calf composition in the population. Lack of snow, storms and high winds limit moose censuses almost annually in Unit 6.

Population Size

The posthunt moose population in Unit 6 during 2000–2001 was approximately 1260 moose, including 280 in Unit 6A East, 350 in 6A West, 230 in 6B, 350 in 6C, and 50 in 6D. Censuses indicated that the moose population in Unit 6C increased from 259 in 1996–1997 to 350 in 1998–1999, a result of high productivity and low winter mortality (Table 1). Moose in Unit 6B decreased because of continued low productivity. Unit 6A West apparently increased substantially, possibly because of movement from Unit 6B. However, we were unable to survey all sample units because of weather, and wide confidence intervals (Table 1) suggest a problem with accuracy. Harvest (Table 2) and calf survival (Table 1) suggest that moose in Unit 6A East declined until 1997 and have since increased.

Population Composition

Aerial surveys indicated that the proportion of calves in both Units 6A West and 6A East was 13% (Table 1). In Unit 6B continued low calf survival – 6% in 1999 and 11% in 1999 – and a declining population since 1996 has prompted conservative bull harvests and no antlerless hunts. Over the past 10 years the proportion of calves in the population has declined in Unit 6B but is showing some indication of leveling off. The proportion of calves in Unit 6C was only 10% during this reporting period, which was a record low. Low calf survival has occurred every 4–6 years in Unit 6C, followed by a rebound. A more recent survey (2002) indicated that calves were back up to 20%.

MORTALITY

Harvest

Season and Bag Limit. In Unit 6A (East), the bag limit for all hunters was 1 moose. The bull moose season during this reporting period was 1 September–31 October. Hunters were restricted to bulls with 50-inch antlers or antlers with 3 or more brow tines on at least 1 side, a regulation first implemented in 1996–1997.

In Unit 6A (West), the season for all hunters was 1 September–31 October, with a bag limit of 1 moose. Residents were allowed to take up to 20 bulls by registration permit, and nonresidents were allowed to take up to 5 bulls by drawing permit. We established an annual allowable harvest for bulls that included both hunts. When that harvest limit was reached, both hunts were closed by emergency order.

The season in Unit 6B was open during 27 August–31 October, during the reporting period for resident hunters only with a bag limit of 1 moose. We authorized a harvest of 10 bull moose by registration permit. No motorized vehicles were allowed for transportation from 15 August–31 August, with the exception of highway vehicles on the maintained surface of the Copper River Highway. Also, moose could not be taken until after 3:00 a.m. following the day on which an airboat was used for transportation. All airboats were required to display an ADF&G identification number. Airboat restrictions were in effect only while the registration permit hunt for bulls was open.

In Unit 6C the season was open for resident hunters only and was 1 September–31 October, with a bag limit of 1 moose by drawing permit. Up to 25 drawing permits were authorized, 20 for bulls and 5 for antlerless moose. During 2000–01 the 5 antlerless moose permits were administered as a federal subsistence hunt by the U.S. Forest Service’s Cordova Ranger District. The general

season in Unit 6D for all hunters was 1–30 September, and the bag limit was 1 bull by harvest ticket.

Board of Game Actions and Emergency Orders. We issued emergency orders to close the registration permit hunts for bull moose in Unit 6B (28 September 1999 and 11 September 2000). The purpose was to limit harvest to ≤ 10 bulls. These were normal management actions. The Board of Game reauthorized antlerless moose hunts in Units 6A–6C.

Hunter Harvest. Reported moose harvest for Unit 6 was 85 in 1999–00 and 89 in 2000–01 (Table 2). We kept harvest low in both Units 6B and 6C because of continued poor calf survival and reduced population in 6B, and to allow a planned population increase in 6C (Nowlin 1998). The harvest was increased in Unit 6A (West) during 2000–01 in response to higher numbers observed.

Composition of the moose harvest in Unit 6 was 85% males during 1999–00 and 89% males during 2000–01, which were in the desired range.

Permit Hunts. During this reporting period, Unit 6A West had 1 registration and 1 drawing permit hunt, Unit 6B had 1 registration hunt, and Unit 6C had 2 drawing hunts (Table 3). Success was very high in drawing hunts (50–100%) but lower in registration hunts (7–45%). Unlimited hunter participation and closures by emergency order when the allowable harvest is reached usually lowers success rates in registration hunts.

Hunter Residency and Success. Local residents comprised 73% of all moose hunters in Unit 6 during the reporting period (Table 4). Alaska residents from other parts of the state comprised 15–23% of hunters, while nonresidents were 12–13%. Conservative and resident-only seasons discouraged nonlocal hunters from participating.

Overall hunter success during both 1999–00 and 2000–01 was 34% and can be attributed conservative seasons and airboat restrictions.

Harvest Chronology. Most of the Unit 6 harvest over the past 2 years occurred during September (Table 5). The harvest pattern has not changed over the past 5 years.

Transport Methods. Boats, primarily airboats, were the most commonly used transport method during this reporting period (Table 6). Airplanes and highway vehicles followed them in decreasing order of importance. This pattern of use has not changed over the past 5 years.

Other Mortality

Weather and predation by brown bears and wolves were causes of calf mortality. Brown bears and radiocollared wolves were observed feeding on neonatal moose in various parts of the unit (Carnes et al. 1996, MacCracken et al. 1997, pers. obs). In addition, brown bear populations increased in Units 6A, 6B, and 6C (Crowley 2000). MacCracken et al. (1997) reported that calf survival was correlated with adverse weather conditions during the calving period in Unit 6C.

HABITAT

Preliminary results indicate that, based on rump fat thickness, moose were in moderate to excellent nutritional status in Unit 6C during 2000–01. Cows with and without calves had mean rump fat thickness of 3.7 and 7.4 cm, respectively, during November. During March those same cows had mean rump fat thickness of 1.7 and 2.8 cm, respectively, similar to cows measured by Stephenson (1995) during March 1992 and 1993. Cows with calves lost less rump fat (an average of 2.0 cm) compared to females without calves (4.6 cm) over winter ($p < 0.01$). Moose body condition on the west CRD is generally better than other populations studied (Stephenson, pers. comm.), indicating adequate winter habitat at the current population level (Table 1).

Nowlin (1998) attempted to protect winter moose habitat in Unit 6A by the deliberate reduction of herd size, although nutritional carrying capacity remains unknown. We have no data on body condition or habitat suitability for Unit 6B. Anecdotal information suggests that a large area of moose habitat in Unit 6B has succeeded into woodland spruce and cottonwood, MacCracken (1992) found these habitat types were the least used for calving in Unit 6C. In addition, advancing alder and spruce along slough banks provide a network of travel corridors for predators.

CONCLUSIONS AND RECOMMENDATIONS

Population goals were achieved in all units except for Unit 6C, in which population size progressed toward our objective of 400 moose by the year 2006. We could not evaluate our objectives for bull:cow ratios because we completed no censuses before mid-December when a significant number of bulls have dropped their antlers and are difficult to distinguish from cows.

We will continue evaluating nutritional status of moose in Unit 6C. In addition, we will attempt to determine calf:cow ratio during spring, summer and fall, and bull:cow ratio in Unit 6C while radio-tracking collared cows.

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Table 1 Unit 6 moose estimated population composition and size, 1992–00.

Unit	Regulatory year	Bulls: 100 cows	Calves(%)	Adults	Population		Total moose observed
					size	90% C.I.	
6A (East)	1992–93	-	8	384	416	373–459	378
	1995–96	-	10	253	282	249–316	162
	2000–01 ^a	-	13	136	-	-	189
6A (West)	1992–93	23	12	259	295	255–334	273
	1995–96	-	14	271	316	272–361	221
	1999–00	-	13	348	412	181–643	382
6B	1992–93	19	17	271	328	268–387	203
	1994–95	22	10	266	296	244–347	182
	1996–97	-	6	289	308	249–367	167
	1998–99	-	9	266	320	243–396	286
	2000–01 ^a	-	11	159	-	-	178
6C	1992–93	26	25	225	299	263–335	204
	1994–95	27	14	242	281	205–358	236
	1996–97	-	17	214	259	232–287	216
	1998–99	-	25	221	334	293–375	293
	2000–01	-	10	319	341	318–365	326

^a Partial survey

Table 2 Unit 6 moose harvest and accidental death, 1996–2000.

Unit	Regulatory year	Hunter harvest					Estimated			Accidental	
		Reported					Unreported	Illegal	Total	death	Total
		M	(%)	F	(%)	Total ^a					
6A (East)	1996–97	16	(100)	0	(0)	16	2	2	4	0	20
	1997–98	10	(100)	0	(0)	10	1	1	2	0	12
	1998–99	13	(100)	0	(0)	13	1	0	1	0	14
	1999–00	17	(100)	0	(0)	17	1	0	1	0	18
	2000–01	19	(100)	0	(0)	19	1	0	1	0	20
6A (West)	1996–97	24	(73)	9	(27)	33	0	2	2	0	35
	1997–98	18	(100)	0	(0)	18	0	2	2	0	20
	1998–99	19	(95)	1	(5)	20	0	2	2	0	22
	1999–00	19	(90)	2	(10)	21	1	1	2	0	23
	2000–01	28	(80)	7	(20)	35	1	1	2	0	37
6A TOTAL	1996–97	40	(82)	9	(18)	49	2	4	6	0	55
	1997–98	28	(100)	0	(0)	28	1	3	4	0	32
	1998–99	32	(97)	1	(3)	33	1	2	3	0	36
	1999–00	36	(95)	2	(5)	38	2	1	3	0	41
	2000–01	47	(87)	7	(13)	54	2	1	3	0	57
6B	1996–97	16	(73)	6	(27)	22	0	3	3	0	25
	1997–98	0	(0)	0	(0)	0	0	2	2	0	2
	1998–99	23	(100)	0	(0)	23	0	0	0	0	23
	1999–00	19	(90)	2	(10)	21	1	1	2	0	23
	2000–01	7	(88)	1	(13)	8	1	1	2	0	10

Table 2 Continued

Unit	Regulatory year	Hunter harvest								Accidental death	Total
		Reported					Estimated				
		M	(%)	F	(%)	Total ^a	Unreported	Illegal	Total		
6C	1996–97	18	(78)	5	(22)	23	1	1	2	0	25
	1997–98	18	(78)	5	(22)	23	1	0	1	0	24
	1998–99	19	(79)	5	(21)	24	0	0	0	0	24
	1999–00	19	(83)	4	(17)	23	1	1	2	2	27
	2000–01	20	(80)	5	(20)	25	1	1	2	3	30
6D	1996–97	1	(100)	0	(0)	1	0	0	0	0	1
	1997–98	2	(100)	0	(0)	2	0	1	1	0	3
	1998–99	0	(0)	0	(0)	0	0	1	1	0	1
	1999–00	3	(100)	0	(0)	3	0	0	0	0	3
	2000–01	2	(100)	0	(0)	2	0	1	1	0	3
Unit 6	1996–97	75	(79)	20	(21)	95	3	8	11	0	106
TOTAL	1997–98	48	(91)	5	(9)	53	2	6	8	0	61
	1998–99	75	(93)	6	(7)	81	1	3	4	0	85
	1999–00	77	(91)	8	(9)	85	4	3	7	2	94
	2000–01	76	(85)	13	(15)	89	4	4	8	3	100

^a Totals may include moose of unknown sex and unit.

Table 3 Unit 6 moose harvest data by permit hunt, 1996–2000.

Unit/hunt no.	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6A/RM160 ^a	1996–97	Bull	73	40	55	45	20	(100)	0	(0)	20
	1997–98	Bull	46	37	52	48	14	(100)	0	(0)	14
	1998–99	Bull	64	52	39	58	20	(95)	1	(5)	21
	1999–00	Bull	75	56	45	52	17	(100)	0	(0)	17
	2000–01	Bull	95	46	53	45	23	(100)	0	(0)	23
6A/DM160 ^b	1996–97	Bull	5	20	0	100	4	(100)	0	(0)	4
	1997–98	Bull	5	20	0	100	4	(100)	0	(0)	4
	1998–99	Bull	5	40	33	67	2	(100)	0	(0)	2
	1999–00	Bull	5	20	50	50	2	(100)	0	(0)	2
	2000–01	Bull	5	0	0	100	5	(100)	0	(0)	5
6A/DM162	1996–97	Antlerles	15	27	18	82	0	(0)	9	(100)	9
	1997–98	No hunt									
	1998–99	No hunt									
	1999–00	Antlerles	5	40	33	67	0	(0)	2	(100)	2
	2000–01	Antlerles	15	53	43	100	0	(0)	7	(100)	7
6B/RM164	1996–97	Bull	172	37	85	15	16	(100)	0	(0)	16
	1997–98	No hunt									
	1998–99	Bull	201	33	83	17	23	(100)	0	(0)	23
	1999–00	Bull	206	36	83	14	19	(100)	0	(0)	19
	2000–01	Bull	171	37	89	7	7	(88)	1	(13)	8

Table 3 Continued

Unit/hunt no.	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6B/DM166	1996–97	Antlerless	10	20	25	75	0	(0)	6	(100)	6
	1997–98	No hunt									
	1998–99	No hunt									
	1999–00	Antlerless	5	20	50	50	0	(0)	2	(100)	2
	2000–01	No hunt									
6C/DM167	1996–97	Bull	20	10	0	100	18	(100)	0	(0)	18
	1997–98	Bull	20	5	5	95	18	(100)	0	(0)	18
	1998–99	Bull	20	5	0	100	19	(100)	0	(0)	19
	1999–00	Bull	20	5	0	100	19	(100)	0	(0)	19
	2000–01	Bull	20	5	0	100	19	(100)	0	(0)	19
6C/DM168	1996–97	Antlerless	5	0	0	100	0	(0)	5	(100)	5
	1997–98	Antlerless	5	0	0	100	0	(0)	5	(100)	5
	1998–99	Antlerless	5	0	0	100	0	(0)	5	(100)	5
	1999–00	Antlerless	5	20	0	100	0	(0)	4	(100)	4
Fed. Subst.	2000–01	Antlerless	6	0	0	100	1 ^b	(17)	5	(83)	6

^a RM prefix was a registration hunt, DM prefix a drawing hunt.

^b Potlatch moose

Table 4 Unit 6 moose hunter residency and success, 1996–2000.

Unit	Regulator year	Successful					Unsuccessful					Total hunter
		Local ^a resident	Nonlocal resident	Nonresident	Total	(%)	^b Local resident	Nonlocal resident	Nonresident	Total	(%) ^c	
6A (East)	1996–97	1	0	15	16	(41)	5	6	12	23	(59)	39
	1997–98	2	1	7	10	(29)	6	4	14	24	(71)	34
	1998–99	2	0	11	13	(62)	5	0	3	8	(38)	21
	1999–00	2	3	12	17	(44)	3	2	17	22	(56)	39
	2000–01	2	5	12	19	(43)	6	4	15	25	(57)	44
6A (West)	1996–97	24	5	4	33	(57)	22	3	0	25	(43)	58
	1997–98	14	4	0	18	(55)	8	7	0	15	(45)	33
	1998–99	13	5	2	20	(61)	11	1	1	13	(39)	33
	1999–00	14	5	2	21	(57)	11	5	0	16	(43)	37
	2000–01	25	5	5	35	(51)	24	9	0	33	(49)	68
6A TOTAL	1996–97	25	5	19	49	(51)	27	9	12	48	(49)	97
	1997–98	16	5	7	28	(42)	14	11	14	39	(58)	67
	1998–99	15	5	13	33	(61)	16	1	4	21	(39)	54
	1999–00	16	8	14	38	(50)	14	7	17	38	(50)	76
	2000–01	27	10	17	54	(48)	30	13	15	58	(52)	112
6B	1996–97	17	5	- ^c	22	(19)	84	11	- ^c	95	(81)	117
	1997–98	0	0	- ^c	0	(0)	0	0	- ^c	0	(0)	0
	1998–99	20	3	- ^c	23	(17)	106	5	- ^c	111	(83)	134
	1999–00	20	1	- ^c	21	(16)	98	13	- ^c	111	(84)	132
	2000–01	7	1	- ^c	8	(8)	92	4	- ^c	96	(92)	104

Table 4 Continued

Unit	Regulatory year	Successful					Unsuccessful					
		Local ^a resident	Nonlocal resident	Nonresident	Total	(%)	^b Local resident	Nonlocal resident	Nonresident	Total	(%) ^c	Total hunter
6C	1996–97	16	7	- ^c	23	(100)	0	0	- ^c	0	(0)	23
	1997–98	23	0	- ^c	23	(96)	1	0	- ^c	1	(4)	24
	1998–99	20	4	- ^c	24	(96)	1	0	- ^c	1	(4)	25
	1999–00	19	4	- ^c	23	(85)	2	2	- ^c	4	(15)	27
	2000–01	22	3	- ^c	25	(100)	0	0	- ^c	0	()	25
6D	1996–97	1	0	0	1	(8)	4	6	2	12	(92)	13
	1997–98	2	0	0	2	(17)	7	3	0	10	(83)	12
	1998–99	0	0	0	0	(0)	3	5	0	8	(100)	8
	1999–00	2	0	1	3	(20)	10	2	0	12	(80)	15
	2000–01	0	2	0	2	(12)	10	5	0	15	(88)	17
Unit 6	1996–97	59	17	19	95	(38)	115	26	14	155	(62)	250
TOTAL	1997–98	41	5	7	53	(51)	22	14	14	50	(49)	103
	1998–99	55	12	13	80	(36)	126	11	4	141	(64)	221
	1999–00	57	13	15	85	(34)	124	25	17	166	(66)	251
	2000–01	56	16	17	89	(34)	133	23	15	171	(66)	260

^a Resident of Unit 6.^b Totals may include harvest by hunters of unknown residency and may include harvest from unknown units.^c Nonresidents ineligible to receive permits.

Table 5 Unit 6 moose harvest percent by time period, 1996–2000.

Unit	Regulatory year	Harvest periods							n
		8/20–8/31	9/1–9/15	9/16–9/30	10/1–10/15	10/16–	11/1–11/30	12/1–12/31	
6A (East)	1996–97	0	25	31	31	13	0	0	16
	1997–98	0	30	40	10	20	0	0	10
	1998–99	0	38	38	15	8	0	0	13
	1999–00	0	18	18	53	12	0	0	17
	2000–01	0	32	26	21	21	0	0	19
6A (West)	1996–97	0	76	18	3	3	0	0	33
	1997–98	0	100	0	0	0	0	0	18
	1998–99	0	100	0	0	0	0	0	20
	1999–00	0	81	5	10	5	0	0	21
	2000–01	0	31	57	11	0	0	0	35
6A TOTAL	1996–97	0	59	22	12	6	0	0	49
	1997–98	0	75	14	4	7	0	0	28
	1998–99	0	76	15	6	3	0	0	33
	1999–00	0	53	11	29	8	0	0	38
	2000–01	0	31	46	15	7	0	0	54

Table 5 Continued

Unit	Regulatory year	Harvest periods							n
		8/20–8/31	9/1–9/15	9/16–9/30	10/1–10/15	10/16–	11/1–11/30	12/1–12/31	
6B	1996–97	9	68	18	5	0	0	0	22
	1997–98	-	-	-	-	-	-	-	0
	1998–99	13	87	0	0	0	0	0	23
	1999–00	11	68	21	0	0	0	0	19
	2000–01	25	75	0	0	0	0	0	8
6C	1996–97	0	65	13	9	13	0	0	23
	1997–98	0	43	43	9	4	0	0	23
	1998–99	0	58	4	29	8	0	0	24
	1999–00	0	57	35	4	4	0	0	23
	2000–01	0	44	28	12	12	4	0	25
6D	1996–97	0	100	0	0	0	0	0	1
	1997–98	0	0	0	0	0	0	0	0
	1998–99	0	0	0	0	0	0	0	0
	1999–00	0	67	33	0	0	0	0	3
	2000–01	0	50	50	0	0	0	0	2
Unit 6 TOTAL	1996–97	2	63	19	9	6	0	0	95
	1997–98	0	58	30	6	6	0	0	53
	1998–99	4	74	8	11	4	0	0	80
	1999–00	2	58	20	14	5	0	0	83
	2000–01	2	39	37	12	8	1	0	89

Table 6 Unit 6 moose harvest percent by transport method, 1996–2000.

Unit	Regulatory year	Airplane	Boat	3- or 4- wheeler	ORV	Highway Vehicle	n
6A (East)	1996–97	88	0	6	0	6	16
	1997–98	80	20	0	0	0	10
	1998–99	77	8	15	0	0	13
	1999–00	76	6	12	0	6	17
	2000–01	53	11	21	0	16	19
6A (West)	1996–97	30	70	0	0	0	33
	1997–98	39	55	0	0	0	18
	1998–99	25	75	0	0	0	20
	1999–00	29	71	0	0	0	21
	2000–01	34	63	0	0	3	35
6A TOTAL	1996–97	49	47	2	0	2	49
	1997–98	54	33	0	0	0	28
	1998–99	45	48	6	0	0	33
	1999–00	50	42	5	0	3	38
	2000–01	41	44	7	0	7	54

Table 6 Continued

Unit	Regulatory year	Airplane	Boat	3- or 4- wheeler	ORV	Highway Vehicle	n
6B	1996-97	27	73	0	0	0	22
	1997-98	0	0	0	0	0	0
	1998-99	22	56	0	0	13	23
	1999-00	18	53	0	0	41	19
	2000-01	0	70	0	0	30	10
6C	1996-97	0	43	0	0	57	23
	1997-98	0	35	0	0	65	23
	1998-99	0	37	4	4	54	24
	1999-00	0	65	9	0	26	23
	2000-01	4	39	0	0	57	23
6D	1996-97	0	0	0	0	100	1
	1997-98	0	0	0	0	100	2
	1998-99	0	0	0	0	0	0
	1999-00	0	33	0	0	67	3
	2000-01	50	0	0	0	50	2
Unit 6 TOTAL	1996-97	32	52	1	0	16	95
	1997-98	28	20	0	0	32	53
	1998-99	25	38	4	1	20	80
	1999-00	27	49	5	0	19	85
	2000-01	27	45	4	0	24	89

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
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MOOSE MANAGEMENT REPORT

From: 1 July 1999

To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 7 (3,520 mi²)

GEOGRAPHIC DESCRIPTION: Eastern Kenai Peninsula

BACKGROUND

The Unit 7 moose population irrupted most recently during the 1960s after wildfires in adjacent Unit 15A created large areas of early seral vegetation. Wolf numbers were simultaneously reduced to low levels. A rapid population decline followed in the early 1970s after 3 severe winters in 4 years. The population has fluctuated at low levels since as predator densities stabilized and habitat succession progressed into less desirable climax stages. The Unit 7 moose population is considered stable at low densities and expected to remain at these levels unless significant habitat alteration occurs.

Since 1980, spruce bark beetles (*Dendroctonus rufipennis*) have established in many old-growth spruce stands in Unit 7. Nearly half a million acres of land on the Kenai Peninsula were infected with spruce bark beetles in 1995 (Peterson 1996) and over 2 million acres by 1999. Nearly all Kenai forest lands have been affected to date. Salvage logging (harvest of dead and infested stands of trees) is ongoing throughout the Kenai (Steve Albert ADF&G personal communication). Reduction of old-growth forests may be beneficial to the moose population by enhancing nutritional quality and availability of winter food plants. However site preparation is crucial to successful moose habitat enhancement.

In 1997 a task force was established to evaluate the biological and sociological effects of selective harvest management in south central Alaska. Members of the task force included agency representatives from the Alaska Department of Fish and Game (ADF&G) and Fish and Wildlife Protection and representatives from the local Fish and Game Advisory Committees to bring in the public perspectives. Hundertmark et al. (in press) and Fulton (in prep) reported results of this task force.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

To maintain a healthy population of moose with a minimum bull to cow ratio of 15:100.

METHODS

All harvest data is collected and reported through the statewide harvest reporting system. Information is collected from hunters on area hunted, transportation used, amount of time spent afield and, if successful, the size of the moose harvested.

Standard late fall composition surveys are completed in standard count areas. We completed aerial sex and age composition surveys in late November under favorable snow conditions. Because most of Unit 7 is mountainous, we surveyed moose by flying elevational contours. All information was entered in the Wildlife Information Data Base (WIDB) software up until 1999 when this software no longer functioned. After 1999, the survey data was maintained in a local database.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Terrain features and extensive mature spruce forest prevent application of the moose census technique described by Gasaway et al. (1986). Standard sex and age aerial surveys combined with harvest reports indicate that the moose population has remained relatively stable since the mid-1980s. The 1998–99 winter was considered severe in most of the region with deep and persistent snow. Documented winter mortality was predominantly calves of the year however we suspect that some adults were also lost. Winter severity was reflected in lower than average hunter harvest in 1999. We believe the moose population remained stable at approximately 1000 animals through 1998 but declined in 1999. No new population estimate has been attempted.

Population Composition

Only one count area, excluding Portage and Placer River drainages, was surveyed during both 1999 and 2000 fall sex and age composition surveys. In 1999 we surveyed 151 moose with ratios of 29 calves:100 cows and 45 bulls:100 cows and in 2000 we surveyed 98 moose with ratios of 8 calves:100 cows and 50 bulls:100 cows (Table 1).

MORTALITY

Harvest

Season and Bag Limit. Two drawing permit hunts were held in GMU 7 during this reporting period. The first hunt was held in the Placer River and Portage creek drainages (DM210). Results of this hunt are reported in the management report for 14C. The second hunt was a newly authorized hunt west of the resurrection creek bordering 15A. The season was October 20 – November 20 and the bag limit was 1 bull with spike-fork or 50-inch antlers. The remainder of the Unit 7 moose season was from 20 August–20 September for 1 bull with spike-fork or 50-inch antlers.

Board of Game Action and Emergency Orders. During the spring 1999 meeting, the BOG authorized a special permit hunt in the Kenai Mountains west of the Resurrection Creek trail for up to 25 permits.

Hunter Harvest. In 1999, 300 hunters reported hunting in Unit 7 during the 20 August–20 September season and harvested 40 bull moose (Tables 2 and 3). Sixteen hunters (40%) reported taking spike/fork bulls (less than 35") compared with 23 hunters (58%) who harvested large bulls (greater than 39") defined as a 50-inch antler spread or having 3 brow tines on at least 1 antler. One additional moose was reported but not classified.

In 2000, 345 hunters reported hunting in Unit 7 during the 20 August–20 September season and harvested 51 bull moose. Ten hunters (20%) reported taking spike/fork bulls compared to 34 hunters (67%) who harvested large bulls. Seven additional moose were reported but not classified.

Permit Hunts. Permit hunt results for Unit 7 (hunts DM210 and DM211) were included in the management report for Unit 14C. Permit hunt results for DM522 are included in Table 4. Two bulls were harvested in 1999 and 4 bulls in 2000. All were classified as 50-inch moose.

Hunter Residency and Success. Successful hunters averaged 5.3 days hunting in both 1999 and 2000. Hunter success in 1999 was 13%. Twelve successful hunters (30%) were unit residents, 16 (40%) were nonunit residents, and 8 (20%) were nonresidents (Table 3). Residency reported for unsuccessful hunters was as follows: unit residents 119 (46%), nonunit residents 120 (46%), and nonresidents 7 (3%).

Hunter success in 2000 was 15%. Sixteen successful hunters (31%) were unit residents, 29 (57%) were nonunit residents, and 5 (10%) were nonresidents (Table 3). Reported residency for unsuccessful hunters was as follows: unit residents 126 (43%), nonunit residents 156 (53%), and nonresidents 11 (4%).

Harvest Chronology. Beginning in 1993 the general open season for Unit 7 was 20 August–20 September (32 days). Harvest chronology indicates the highest percentage occurred during the first 5 and last 10 days of the season (Table 5). A few more moose were typically taken near the end of the season when moose were probably moving to alpine and subalpine rutting areas.

Transport Methods. In 1999, 48% of successful hunters reported highway vehicles as their means of transportation (Table 6). Airplanes were the second most common transportation means (25%) for successful hunters. Hunters using horses, boats and ORV's accounted for 13%, 2%, and 2%, respectively, of the reported harvest.

In 2000, 41% of successful hunters reported highway vehicles as their means of transportation (Table 6). The second most common transportation means for successful hunters was by horseback (29%). Hunters using aircraft, boats, ORV's and ATVs, accounted for 12%, 8%, 2% and 2%, respectively, of the reported harvest.

Other Mortality

In addition to reported harvest in Unit 7, 27 moose were killed; 3 by trains and 24 by motor vehicles during the 1999–2000 winter. There were no reported train kills for the 2000–2001 winter. At least 24 moose were killed in Unit 7 by motor vehicles during this same winter (Table 2). Approximately 75% of these animals were salvaged for human use. The "Give Moose a Brake" program (Del Frate and Spraker, 1991) continued its awareness activities throughout the

peninsula. Crippling loss by hunters is unknown but probably less than 10% of the reported harvest.

Effects of predation by wolves and bears are unknown. The unit supports an estimated 50 wolves, a ratio of 1 wolf per 20 moose. Black bears are abundant throughout the unit, and brown bears are common in all drainages supporting salmon.

HABITAT

Assessment

Reduction of some old-growth forest in response to spruce bark beetle infestations through logging and prescribed burning by the U.S. Forest Service was a priority in Unit 7. Logging prescriptions and reforestation techniques that encourage hardwood production were recommended. If hardwood production increases in these affected areas, moose will probably benefit from the higher-quality habitat. However, if site preparation is not adequate, grass (*Calamagrostis* sp.) will compete with both spruce and hardwood seedlings and habitat quality will decline.

CONCLUSIONS AND RECOMMENDATIONS

Winter conditions in Unit 7 during 1998–99 were moderately severe, and many calves were lost throughout the region, lowering harvest rates in 1999. The following winter was mild with fair calf survival and slightly higher harvest in the fall. Human-caused moose mortality, including road or train kills and harvest, represented approximately 10% of the estimated moose population of 900–1000.

The harvest of moose under spike-fork/50 inch regulations fluctuates in response to previous winter severity. Spike-forks are almost always yearlings, and the proportion of young animals in the harvest should provide a "barometer" of the health of that particular cohort. By properly evaluating the severity of a particular winter, we can also forecast the upcoming harvest.

The bull-to-cow ratios have been higher than the recommended minimum objective of 15 bulls per 100 cows since the selective harvest program began. However the survey area may not accurately reflect the ratio across the unit. Adequate bull-to-cow ratios are desired to minimize the length of the rut and ensure that most cows conceive during their first estrous cycle (Schwartz et al. 1994). Given the low moose density and rugged terrain of Unit 7, a higher bull-to-cow ratio may be necessary and desirable to maintain a healthy population.

Under the current selective harvest system and current harvest patterns, we recommend no changes in regulations. If bull-to-cow ratios continue above objective levels, specific drainages may be designated for late season permit hunts similar to DM522. However, additional funding for more intensive survey efforts would be necessary. To avoid shifts in hunting pressure, Unit 7 and 15 general seasons should be kept consistent.

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Table 1. Unit 7 fall aerial moose composition counts and estimated population size, 1992–2000.

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	moose observed	Moose /hour	population size
1992–93	34	7	18	12	218	248	24	1000
1993–94 ^a	--	--	--	--	--	--	--	--
1994–95	34	18	31	19	367	453	40	1000
1995–96 ^a	--	--	--	--	--	--	--	--
1996–97	41	4	13	9	181	198	23	1000
1997–98 ^a	--	--	--	--	--	--	--	--
1998–99	43	8	12	8	227	246	36	900
1999–2000	45	8	29	17	126	151	84	900
2000–2001	50	8	8	5	88	98		900

^a No surveys completed.

Table 2. Unit 7 moose harvest ^a and accidental death, 1992–2000.

Regulatory year	Reported				Estimated			Accidental death			Grand Total
	M	F	Unk.	Total	Unreported	Illegal	Total	Road	Train	Total	
1992–93	54	0	0	54			20	31	0	31	105
1993–94	62	0	0	62			20	30	4	34	96
1994–95	56	0	0	56			20	34	18	52	108
1995–96	42	0	0	42			20	18	4	22	84
1996–97	61	0	0	61			20	27	8	35	116
1997–98	69	0	0	69			20	28	18	46	115
1998–99	46	0	0	46			20	46	7	53	119
1999–2000	40	0	0	40			20	24	3	27	87
2000–2001	51	0	0	51			20	24	0	24	95

^aExcludes permit hunt harvest.

Table 3. Unit 7 moose hunter^a residency and success, 1992–2000.

Regulatory year	Successful				Unsuccessful				Total Hunters
	Local ^b resident	Nonlocal resident	Nonresident	Total ^c (%)	Local ^b resident	Nonlocal resident	Nonresident	Total ^c (%)	
1992–93	24	26	4	54 (12)	166	205	6	379 (88)	433
1993–94	19	28	14	62 (15)	156	185	5	351 (85)	413
1994–95	22	27	4	56 (13)	141	203	13	369 (87)	425
1995–96	21	17	4	42 (13)	148	133	6	289 (87)	331
1996–97	24	29	8	61 (18)	157	130	8	295 (82)	340
1997–98	24	41	4	69 (19)	144	140	9	293 (81)	362
1998–99	23	20	3	46 (12)	147	182	14	343 (88)	389
1999–2000	12	16	8	40 (13)	119	120	7	260 (87)	300
2000–2001	16	29	5	51 (15)	126	156	11	294 (85)	345

^a Excludes hunters in permit hunts.

^b Local = residents of Unit 7.

^c Total columns include hunters that did not specify residency

Table 4. Units 7 moose harvest data by drawing permit hunt, 1996–2000.

Hunt Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males	Females	Unk.	Illegal	Total harvest
DM522	1996/97							--	--	
	1997/98							--	--	
	1998/99							--	--	
	1999/2000	25	16	90	10	2	0	--	--	2
	2000/2001	25	32	76	24	4	0	--	--	4

^aNew hunt in 1999.

Table 5. Unit 7 moose harvest^a chronology percent by time period, 1992–2000.

Regulatory year	Harvest periods						Unknown	<i>n</i>
	8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20		
1992–93 ^b	--	--	26	11	26	30	7	54
1993–94 ^c	15	3	11	6	32	27	5	62
1994–95 ^c	25	13	18	11	7	21	5	56
1995–96 ^c	26	14	7	5	10	33	5	42
1996–97 ^c	20	10	15	15	11	25	3	61
1997–98 ^c	23	6	12	6	19	32	3	69
1998–99 ^c	28	2	11	13	28	13	4	46
1999–2000	10	10	13	23	20	20	5	40
2000–2001	22	4	24	2	27	16	6	51

^a Excludes permit hunt harvest.

^b General open season Sep 1–Sept. 20;

^c General open season Aug. 20–Sep 20.

Table 6. Unit 7 moose harvest^a percent by transport method, 1992–2000.

Regulatory year	Percent of harvest							Unknown	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle		
1992–93	16	13	13	4	0	0	51	4	55
1993–94	15	19	18	0	0	3	40	5	62
1994–95	9	20	16	4	0	0	45	7	56
1995–96	5	19	5	7	0	0	57	7	42
1996–97	7	21	7	5	0	3	56	2	61
1997–98	9	17	13	3	0	1	49	7	69
1998–99	7	20	11	4	0	4	50	4	46
1999–2000	25	13	2	0	0	2	48	10	40
2000–2001	12	29	8	2	0	2	41	6	51

^a Excludes permit hunt harvest.

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 9 (33,600 mi²)

GEOGRAPHIC DESCRIPTION: Alaska Peninsula

BACKGROUND

Moose were scarce on the Alaska Peninsula before the mid 1900s, but they increased dramatically and spread to the southwest during the 1950s and 1960s. The scarcity of suitable habitat south of Port Moller limited expansion into Unit 9D. Even during the 1960s when the population was growing, calf:cow ratios were relatively low, and the ratio declined as the population reached its peak. Evidence of range damage from overbrowsing was evident, and nutritional stress probably caused poor calf survival. Liberal hunting regulations were in effect from 1964 to 1973, first to slow population growth and subsequently (during the early 1970s) to reduce the population so that willow stands could recover from heavy browsing. Even though a series of hunting restrictions began after 1973, the population continued to decline, especially in Unit 9E. By the early 1980s moose densities in Unit 9E were 60% below peak levels and calf:cow ratios were extremely low, despite evidence that range conditions had improved (ADF&G files). Brown bear predation on neonatal moose was the primary limiting factor of moose in Unit 9.

MANAGEMENT DIRECTION

POPULATION OBJECTIVES

Population objectives for moose in Unit 9 are to 1) maintain existing densities in areas with moderate (0.5–1.5 moose/mi²) or high (1.5–2.5 moose/mi²) densities; 2) increase low-density populations (where habitat conditions are not limiting) to 0.5 moose/mi²; 3) maintain sex ratios of at least 25 bulls:100 cows in medium-to-high density populations and at least 40 bulls:100 cows in low-density areas.

METHODS

We scheduled fall sex and age composition aerial surveys throughout Units 9B, 9C, and 9E during November through early December when adequate snow cover was available. We

collected harvest data from harvest tickets, monitored harvests, and checked hunters primarily within the Naknek River drainage.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Results of fall sex and age composition surveys in Units 9B, 9C, and the central portion of 9E indicated that populations in most of Unit 9 have stabilized over the past 15 years. Very low moose densities and unreliable snow conditions in Unit 9A, 9D, and the southern portion of 9E precluded efficient surveys for monitoring trends in population size or composition. Incidental observations during caribou surveys south of Port Moller showed a modest expansion of moose in that area. The U.S. Fish and Wildlife Service (FWS) did a partial survey in February 1999 and counted 101 moose, of which 20 were calves.

In March 1999, the Board of Game found that moose in Units 9B, 9C, and 9E met the criteria to be considered “important for providing high levels of human consumptive use” under the intensive management legislation.

Population Size

A 1983 census in the central portion of Unit 9E resulted in an estimate of 1148 moose (90% CI = $\pm 16\%$) in the 1314-mi² study area. Extrapolation of this census to the remainder of Unit 9E provided a rough estimate of approximately 2500 moose. The area of Unit 9C outside of Katmai National Park had approximately 500–600 moose. There were approximately 2000 moose in Unit 9B. Units 9A and 9D probably contained about 300 and 200 moose, respectively.

Population Composition

During this reporting period, survey efforts in Unit 9B have been minimal (Table 1). The Nakeen trend area, a small, somewhat isolated “pocket” of moose between Naknek and Levelock in southwestern 9B, was surveyed in 1997, 1998, and 1999. A survey was aborted in 2000 due to poor snow conditions and turbulence. This area receives heavy local hunting pressure, and has the lowest bull:cow ratio ($\bar{x} = 17$ bulls:100 cows during 1997–1999) of any trend area in Unit 9. The Big Mountain trend area on the southeast side of Lake Iliamna was surveyed in 1998 and 1999. This area, despite increasing hunting pressure, continues to have the highest bull:cow ratio ($\bar{x} = 103:100$) in Unit 9. An aircraft mishap cancelled efforts to survey trend areas in northern 9B in 1998.

The 3 trend areas in Unit 9C were surveyed 1999, but only the Branch River area was surveyed in 2000 (Table 2). Total counts and bull:cow ratios were relatively stable during this period. Calf:cow ratios in Unit 9C, like the rest of the unit, were extremely low in 1999 and 2000.

Survey efforts were expanded in Unit 9E during 1998 and 1999 (Table 3) in cooperation with the FWS and NPS, but extremely poor snow conditions in 2000 precluded any efforts. In addition to surveying most traditional trend areas in 1998, the Pacific drainages from Amber Bay to Chignik Bay were covered for the first time. The bull:cow ratios in all areas surveyed exceeded the management objective of at least 40:100, with an overall ratio of 65 bulls:100 cows. The ratio of

20 calves:100 cows in 1998 was among the highest observed in Unit 9E in the past 25 years. This ratio, however, was only 10:100 in the limited area surveyed in 1999, which included the first coverage of Pacific drainages from Wide Bay to Nakalilok Bay. In 1998 and 1999, 37% of all bulls seen ($n = 257$) had antlers with ≥ 50 " spread. Total sample sizes and ratios from these areas indicate the population is relatively stable and harvests are not reducing the number of bulls below management objectives.

MORTALITY

Harvest

Seasons and Bag Limit. As federal subsistence management becomes more entrenched, the number of regulation changes and divergence of state and federal regulations is increasing. In Unit 9A resident and nonresident hunters could hunt from 1–15 September, and the bag limit was 1 bull. In Unit 9B nonresidents could hunt from 5–15 September with a bag limit of 1 bull with ≥ 50 -inch antlers or ≥ 4 brow tines; and resident hunters could hunt from 1–15 September and, beginning in 1999, 15 December–15 January, with a bag limit of 1 bull. Effective in 1997, meat of moose taken in Unit 9B was required to remain on the bone until processed for human consumption.

The federal subsistence season in Unit 9B is from 20 August–15 September and 1 December–15 January. The nonresident season dates were the same as for Unit 9B; however, the nonresident bag limit remained at 1 bull with ≥ 50 -inch antlers or ≥ 3 brow tines. The resident fall season has remained the same as 9B, but beginning in 1999 the resident winter season dates in Unit 9C have varied between the Naknek River drainage and the remainder of 9C. Within the Naknek drainage only bulls could be taken and the season was 1–31 December. In the remainder of 9C, any moose was legal from 15 December–15 January. Within the southern portion of the Naknek drainage, the federal subsistence season was open from 20 August–15 September under a registration permit. During December, federal lands were only open to local rural residents and a subsistence registration permit was required to take antlerless moose. In the remainder of 9C, the federal winter subsistence winter season was 1–31 December and any moose was legal outside the Naknek drainage. In 9E the nonresident season was 10–20 September, and the bag limit was 1 bull with an antler spread of ≥ 50 inches or at ≥ 3 brow tines on at least 1 antler.

The state season for resident hunters in Unit 9E was 10–20 September and, beginning in 1999, 1 December–20 January. The bag limit in Unit 9E was 1 bull; however, moose taken from 10–20 September must be a spike/fork or have an antler spread of ≥ 50 inches or have ≥ 3 brow tines on at least 1 antler. The federal subsistence seasons in Unit 9E were 1–20 September and 1 December–20 January with a bag limit of 1 bull. Beginning in 1999, 9D was open to residents only under a state drawing permit (hunt DM312) from 15 December–20 January; and 10 permits were issued for any bull.

Board of Game Actions and Emergency Orders. Several changes to both state and federal moose regulations were enacted for the 1999 regulatory year. The state's winter season in Unit 9B and that portion of Unit 9C outside the Naknek drainage was moved back to 15 December–15 January, and federal season was extended to 1 December–15 January. In Unit 9E, both the state and federal winter seasons were extended to 1 December–20 January. For the first time since

Unit 9D was established, a moose hunt was authorized under a resident-only drawing permit hunt conducted from December 15–20 January, with 10 permits issued.

Hunter Harvest. During 1999, hunters reported killing 253 moose, including 238 bulls and 8 cows (Table 4). In 2000, the reported harvest was 164 moose, including 161 bulls and 2 cows. The 2000 harvest was the lowest in over 20 years. The Unit 9 harvest over the past 18 years has averaged 212 (range 164–300).

Permit Hunts. Federal subsistence registration permits are required for the early fall season (RM233) and the December cow hunt (RM232) within the Becharof National Wildlife Refuge in 9C. A quota of 5 antlerless moose was set for RM232. Since 1996, a total of 12 permits have been issued for RM233 and no moose have been taken. During 1996–2000 a total of 37 permits have been issued for RM232, and 9 cows were killed, but none since 1997.

Twenty people applied for 10 available permits in the new DM312 moose hunt in Unit 9D. Because of the logistical problems in participating in a winter hunt in Unit 9D, the Board of Game stipulated that successful applicants had to notify the department that they actually intended to hunt. In 1999 four people failed to confirm they were planning to hunt, so these permits were issued to people on an alternate list. Of the 10 people who got permits, 4 reported hunting and 1 bull was taken. In 2000, 24 people applied and three additional permits were issued to replace original winners who indicated they would not hunt. Only one person reported hunting, and no moose were taken.

Hunter Residency and Success. The number of moose hunters using Unit 9 increased during 1981–87 and peaked at 645. Since then the number leveled off at a mean of 563 for the period 1990–96. In 1997, 1998, 1999 514, 525, and 524, moose hunters reported using Unit 9, respectively (Table 5). For 2000, only 461 hunters reported using Unit 9. While there have been fluctuations in the proportion of the 3 residency categories, overall no group has shown an increase. Most subsistence hunters did not get moose harvest tickets and consequently were not represented in the local resident category. Since 1988 the success rates have been relatively stable for all 3 residency groups. Nonresidents have a higher success rate (50%, range = 43–59%) than either residents of Unit 9 (35%, range = 26–51%) or other Alaska residents (31%, range = 19–38%) because virtually all of them flew out to hunt, and many employed guides.

Harvest Chronology. Since 1988, approximately 89% of the total moose harvest was during September. Harvest levels during the winter season have remained low, but during 1996–2000 varied (range = 3–15% of total), depending on weather and travel conditions (Table 6).

Transportation Methods. Aircraft continued as the most common method of transportation in Unit 9; boats were the second most common transport mode (Table 7). No major change in transportation type has occurred in the past 5 years.

Other Mortality

Given the continued low calf production, bear predation of neonatal moose remained the apparent primary cause of natural mortality. Bear:moose ratios in Unit 9 ranged from >1:1 to 1:10, and they were much higher than anywhere else within the indigenous range of moose.

Conditions during the first half of the 1999–00 winter were the worst in 25 years, with deep snow and heavy drifting. However, by February conditions moderated and winter mortality seemed insignificant. The 2000–01 winter was extremely mild with virtually no snow accumulation.

CONCLUSIONS AND RECOMMENDATIONS

Hunting regulations have been restricted in all units, except the Branch River Drainage in 9C, to eliminate antlerless moose hunting because of low calf:cow ratios. Additionally, fall seasons have recently been shortened and moved to the first half of September in the northern 3 units to maintain bull:cow ratios at prescribed levels. Harvests have remained relatively stable for 17 years, despite major changes to moose regulations (i.e., the spite/fork-50” regulation) in other parts of Alaska. The recent average harvest of 225 moose per year appears to be within sustainable levels. Local residents in Units 9B and 9E would like to reinstitute cow hunts, but unless productivity improves, this request will be difficult to justify on biological grounds. Local residents have also voiced concern over what is perceived as increasing competition from other hunters, including a growing effort by air taxi operations during the December hunt, especially in Unit 9B. Also many local hunters preferred a later winter hunt when travel conditions are better for snowmachines. These allocation questions were addressed at the 1999 Board of Game meeting and resulted in the winter season being moved later in Unit 9B and the northern portion of Unit 9C and extended in Unit 9E.

The drawing moose hunt (DM312) in 9D has only resulted in 1 bull being taken since its inception in 1999. The hunt was under subscribed in 2001. A federal subsistence registration hunt was established in 2002. I recommend that the state hunt be changed to a general resident season with the same dates.

Brown bear predation on neonatal moose was the major limiting factor preventing the increase in moose densities in Unit 9. However, very high bear:moose ratios would require substantial reduction in bear densities to achieve a measurable improvement in moose calf survival. ADF&G has placed a priority on managing bears in Unit 9, and any drastic reduction in bear numbers would probably be opposed by a large segment of the public.

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Table 1 Unit 9 fall aerial moose composition counts, 1996–2000

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour
1996	--	--	--	--	--	--	--
1997	8	2	35	25	52	69	33
1998	48	7	19	11	189	213	19
1999	57	10	4	2	132	135	26
2000	--	--	--	--	--	--	--

Table 2 Moose composition counts in Unit 9C, 1996–2000

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour
1996	27	7	23	16	501	592	40
1997	44	7	14	9	467	512	44
1998	--	--	--	--	--	--	--
1999	37	3	9	6	516	550	38
2000	33	2	7	5	290	306	52

Table 3 Moose composition counts in Unit 9E, 1996–2000

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour
1996	50	11	28	15	281	331	36
1997	--	--	--	--	--	--	--
1998 ^a	65	13	20	11	817	913	45
1999	48	6	10	6	154	164	43
2000	--	--	--	--	--	--	--

^a Includes some surveys by U.S. Fish and Wildlife Service.

Table 4 Annual moose harvest in Unit 9, 1996–2000

Year	Reported			Estimated			Total
	M	F	Total ^a	Unreported	Illegal	Total	
1996	222	15	238	100		100	338
1997	232	5	237	100		100	332
1998	199	2	201	100		100	302
1999	238	8	253	100		100	339
2000	175	2	178	100		100	278

^a Includes unknown sex.

Table 5 Moose hunter residency and success in Unit 9, 1996–2000

Year	Successful				Unsuccessful			
	Local resident	Nonlocal resident	Non resident	Total ^a	Local resident	Nonlocal resident	Non-resident	Total
1996	55	57	121	238	101	112	117	333
1997	62	42	130	232	86	95	99	282
1998	33	48	116	202	95	113	118	323
1999	53	61	131	239	111	98	124	285
2000	36	29	112	178	109	69	105	283

^a Includes unknown residency.

Table 6 Moose harvest chronology (%) in Unit 9, 1996–2000

Year	8/20-8/31	9/1-9/4	9/5-9/9	9/10-9/15	9/16-9/20	12/1-12/15	12/16-12/31	1/1-1/20
1996	<1	8	21	48	17	5	8	--
1997	<1	7	16	42	20	8	7	--
1998	<1	6	17	47	21	6	3	--
1999	<1	3	21	45	17	5	5	4
2000	<1	6	18	51	22	0	3	0

Table 7 Successful moose hunter transport methods (%) in Unit 9, 1996–2000

Year	Airplane	Horse	Boat	3- or 4- wheeler	Snowmachine	ORV	Highway vehicle
1996	62	0	20	5	9	1	3
1997	59	0	19	4	12	0	3
1998	66	0	24	2	5	0	1
1999	64	0	18	4	10	0	2
2000	63	0	24	6	2	1	1

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
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MOOSE MANAGEMENT REPORT

From: 1 July 1999

To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 11 (13,300 mi²)

GEOGRAPHIC DESCRIPTION: Chitina Valley and the eastern half of the Copper River Basin

BACKGROUND

Moose abundance in Unit 11 was generally considered low from the early 1900s until the 1940s, increased during the 1950s, and reached a peak population in the early 1960s. When moose were most abundant, we observed between 85 and 120 moose per hour during fall composition counts. The moose population declined from the late 1960s until 1979, when the population was considered to have reached its lowest level. In 1979 only 12 moose per hour were observed during fall counts. Moose numbers stabilized, then started increasing in Unit 11 during the early to mid 1980s and probably peaked in 1987 when we observed 55 moose per hour. Moose numbers declined between 1990 and 1991 following severe winters, then increased slightly during the mid 1990s.

Moose harvests in Unit 11 averaged 164 (123–242) per year from 1963 until 1974. Either-sex bag limits were in effect until 1974, and cows composed up to 50% of the harvest. During this period, hunting seasons were long and split between a fall and winter season. The moose harvest and the total number of hunters peaked in the early 1970s. In response to declining moose numbers, the 1974 fall moose season was shortened, the winter season was closed, and the harvesting of cows was prohibited. Between 1975 and 1989, fall seasons remained 1–20 September. In 1990 the moose season was shortened in response to deep snow conditions and to align it with the Unit 13 season. The current state season and bag limit was established in 1993.

Most of Unit 11 was included in Wrangell–Saint Elias National Monument in December 1978. In 1980 monument status was changed to park/preserve with passage of the Alaska National Interest Lands Conservation Act.

MANAGEMENT DIRECTION

POPULATION OBJECTIVE

- Allow the population to fluctuate as dictated by available habitat and predation rates.

- Maintain a population with a posthunt minimum of 30 bulls:100 cows with 10–15 adult bulls:100 cows.

HUMAN USE OBJECTIVE

- Allow human harvest of bulls when it does not conflict with management goals for the unit or population objectives for the herd.

METHODS

An aerial survey was conducted every year during the late fall to determine sex and age composition and population trends on a count area along the western slopes of Mount Drum. We monitored harvests and hunting pressure through a harvest ticket reporting system; we also monitored the average reported antler spread in the harvest. Predation and overwinter mortalities were monitored in the field whenever possible and by reports from hunters and trappers.

Large portions of Unit 11 are classified as limited fire suppression zones where wildfire is allowed to burn. Unfavorable weather conditions for burning have occurred in recent years and wildfires impacted little or no habitat this reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

The number of moose observed during fall sex and age composition surveys in Count Area (CA) 11 (the western slopes of Mount Drum) declined during this reporting period (Table 1). Historically, the number of moose counted has fluctuated between years on this count area. Moose movements and survey conditions probably account for some of the yearly variation. The average number of moose observed over three year periods were compared to smooth annual variation in survey results due to snow condition and sightability. From 1994–96, an average of 132 moose (.46 moose/mi²) were observed. The three-year average between 1999 and 2001 was 106 moose (.37 moose/mi²), down 20% from the 1994–96 time period. Though not definitive, this trend data suggests that the population in Unit 11 may be declining.

Population Size

An accurate population estimate is not available for all of Unit 11 because a complete census has never been conducted. Moose numbers observed during the 2001 fall composition counts in CA-11 resulted in a density estimate of 0.3 moose per mi². Density estimates from 0.1 to 0.4 moose/mi² were calculated in 1986 during late winter stratification surveys when 20% of the estimated 5200 mi² of moose habitat in the unit was surveyed. Based on these density estimates, an extrapolated population estimate of approximately 2500 moose was obtained. During the fall of 1993, NPS biologists conducted a Gasaway census in portions of Unit 11. The density estimate was 0.58 moose/mi² and the extrapolated population estimate from this survey was 3000 moose (Route, personal communication). Recent declines in the number of moose counted on CA-11 suggests moose abundance may be lower now than the 1993 National Park Service estimate.

Population Composition

The bull:cow ratio in CA-11 in 2001 was 94:100 (Table 1). The bull:cow ratio has averaged 120:100 for the 5 years between 1997 and 2001. These bull:cow ratios have been among the highest ever observed in CA-11. This adult bull:cow ratio greatly exceeds the current management goal of maintaining no less than 15 adult bulls:100 cows.

The calf:cow ratio in CA-11 was 9:100 in 2001, down 62 percent from the 2000 ratio of 24:100 (Table 1). Fall calf:cow ratios in CA-11 fluctuate considerably annually, with a 3-year average of 18 calves/100 cows. This low level of recruitment is insufficient to allow moose numbers to increase.

Distribution and Movement

Data from past fall composition and winter stratification surveys, field observations, and reports from the public indicate that the highest moose numbers in the unit are along the slopes of Mt. Sanford, Mt. Drum, and Mt. Wrangell. Portions of Unit 11 south of the Chitina River have the lowest density of moose in the unit.

Fall rutting and postrutting concentrations normally occur in upland habitats to elevations as high as 4000 ft. Migrations to lower elevations are initiated by snowfall but usually do not occur until late November–early December. By late winter, moose numbers in riparian habitats along the Copper and Chitina Rivers are at their highest levels for the year. Some moose from the western slopes of Unit 11 move to lower elevations in a westerly direction across the Copper River to winter in eastern Unit 13.

MORTALITY

Harvest

Seasons and Bag Limit.

State

Unit 11	20 Aug–20 Sep	1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least 1 side.
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Federal Subsistence

Unit 11	20 Aug–20 Sep	1 bull by registration permit.
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Board of Game Actions and Emergency Orders. During the spring 1993 board meeting, the Unit 11 season was changed to 20 August to 20 September, and the bag limit was changed to 1 bull with spike-fork antlers or antlers with a minimum 50-inch width or 3 brow tines. These changes were in effect for the 1993 season. This action aligned the state moose season and bag limit in most game management units on the road system in Southcentral Alaska. In 2000 the National Park Service initiated a registration permit hunt for federal subsistence hunting in Unit 11 by

residents of designated communities in the resident zones of Units 11 and 13. The season dates are 20 Aug to 20 Sept.

Human-induced Mortality. The combined state and federal harvest for moose in Unit 11 during 2000 was 45 moose (Table 2). Thirty moose were taken under state regulations and 15 under federal. Moose harvests have been increasing during this reporting period after reaching a low of 27 bulls taken in 1998. Hunting pressure increased in 2000 with 110 individuals reported hunting under the state harvest ticket and 162 rural residents obtaining federal subsistence moose permits. During the late 1980s, an average of 187 individuals reported hunting moose in Unit 11 but this effort had dropped to an average of 118 during the mid 1990s. The current increase in hunting effort in Unit 11 reflects displacement of hunters from Unit 13, where moose hunting opportunities have declined dramatically.

Illegal and unreported harvests of both bulls and cows have been documented in Unit 11 and, in some years, may be as much as 20% of the reported harvest. Poaching activity is assumed to be greatest along the Nabesna and McCarthy Roads where vehicle access allows for hunting and transporting illegally taken moose without being observed. It is also unknown how many small bull moose are taken and reported as legal under federal registration permit. With 2 different bag limits enforced for the same area, it is difficult to limit the harvest of small bulls because they are legal under the federal subsistence regulations.

Hunter Residency and Success. Table 3 gives residency breakdowns for successful and unsuccessful moose hunters in the state hunt. Local rural residents accounted for 70% (n=28) of the total moose taken in Unit 11 during 2000 while nonresidents only took 10% (n=4) with the remainder going to nonlocal Alaskan residents. One reason for higher success rates for local subsistence hunters is that NPS regulations allow only local rural residents to hunt in those portions of the unit designated as Park. Because nonlocal residents and nonresidents can hunt only on preserve lands, they are excluded from much of the unit. Also, local residents can take any size bull under current subsistence regulations on federal lands, while nonlocals and nonresidents must take a spike-fork or 50-inch bull under state regulations.

The hunter success rate in 2000 was 27% for the state hunt, down from the 5-year average of 31%. The decline in 2000 success rate for the state hunt could be attributed to some hunters reporting under the federal permit. Success rates for federal hunters are unknown. Successful hunters spent an average of 5.8 days to kill a moose in 2000, while unsuccessful hunters averaged 7.7 days in the field. The time spent hunting and the time needed to take a moose declined during this reporting period. From 1995 through 1999, successful hunters averaged 7.1 days hunting and unsuccessful hunters 10 days.

Harvest Chronology. Chronology data indicate more moose are taken during the later portion of the season in Unit 11 (Table 4). Bull moose are more vulnerable in the latter part of the season because their movements increase at the onset of rut in mid September, which is also during leaf fall.

Transportation Methods. Unit 11 moose hunters use aircraft, 3-or 4-wheelers and highway vehicles for access to hunting areas (Table 5). NPS regulations limit transportation methods in Unit 11. Aircraft cannot be used in portions of the unit designated as park, and all vehicle use for

sport hunting is restricted to existing trails except by permit. Only subsistence hunters do not need a permit and are not limited to existing trails. These rules limit hunting opportunity in the more remote portions of the unit.

Natural Mortality

Predator-prey studies have not been conducted in Unit 11. Wolves and brown bears are abundant, but predation rates are unknown. Field observations of wolf kills during winter, coupled with reports by hunters and trappers of suspected wolf predation, indicate that wolves are important predators of moose in the unit. Brown bear predation was less apparent because it does not occur during winter when it would be easier to detect. The low calf:cow ratios observed during fall counts indicate early calf mortality similar to that observed in areas with high brown bear predation on neonatal moose calves. Because this unit has a very low-density moose population, predation could limit recruitment and maintain moose at current low densities. Predation can suppress moose populations at very low densities for long periods, especially when alternative prey such as caribou and sheep are available, as they are in Unit 11, and help to keep wolf numbers high (Gasaway et al. 1983).

HABITAT

Assessment

Fires occurred throughout much of Unit 11 before the mid 1940s when the Bureau of Land Management (BLM) instituted fire suppression activities. The beneficial effects of those fires were reached in the 1960s and moose numbers were high over much of the unit. Only one fire, the Wilson Camp Fire, has burned enough acreage in the past 30 years to produce a substantial amount of moose browse. That fire occurred in 1981 and covered 13,000 acres. Recent fire starts have either received initial fire suppression activities, or if not put out, have not had favorable burning conditions or fuel supplies. Currently, vast areas within the unit support stands of mature spruce, many of which have been killed by spruce bark beetles and have limited value as moose habitat. Habitat types that moose currently use are climax upland and riparian willow communities.

Enhancement

Habitat manipulation to benefit moose is not currently an option because most of the unit is included in Wrangell–Saint Elias National Park and Preserve. Although NPS regulations prohibit habitat manipulation, Unit 11 is included in the Copper River Fire Management Plan with most remote areas under the limited suppression category.

CONCLUSIONS AND RECOMMENDATIONS

Moose numbers may have declined slightly during this reporting period. Although this conclusion is based on a decline in the number of moose counted in only one count area, a much more drastic decline has been well documented in adjacent Unit 13. Both units are similar in that they have relatively high numbers of both brown bears and wolves. Calf predation has been documented as an important factor in the moose decline in Unit 13. Calf ratios in Unit 11 are as low or lower than those observed in Unit 13 and are probably too low to allow growth of this moose population. The outlook for the Unit 11 moose population is probably one of slight

increases or decreases, depending on predation from year to year, but overall moose numbers are expected to remain very low for an extended period of time.

Moose hunting patterns changed considerably in Unit 11 during this reporting period. Prior to this reporting period, hunting pressure and harvest were declining. This trend reversed itself in 1999 with both hunting pressure and the harvest increasing. Although the reasons for this change are not known, I surmise that more hunters were displaced from Unit 13 because of the dramatic decline in both moose numbers and the harvest. Also, prior to 2000 all moose hunting was monitored under the state harvest ticket system, including the federal subsistence harvest. In 2000, the National Park Service initiated a registration permit hunt for the federal subsistence hunt and hunting pressure and harvests reached levels not seen in over 10 years. Whether this effort will continue is unknown because moose numbers are lower than in the late 1980s when similar hunting effort existed. The large increase in federal hunters undoubtedly increased the harvest on smaller bulls protected under the state SF/50 regulation. Once these available bulls are harvested, the overall take may decline because calf production/survival is low and bull recruitment can not support high harvest for very long.

I recommend a research program be established to investigate factors limiting growth of the moose population. Unit 11 has the potential to support more moose. The population objective of maintaining moose at existing densities (i.e., 0.1 and 0.7 moose/mi²) needs to be reconsidered and perhaps increased. We also need to explore options available to managers to enhance the moose population consistent with NPS regulations. I also recommend reviewing the control and enforcement of the moose harvest in Unit 11. Dual management creates numerous enforcement and reporting problems such as taking illegal moose on state or private land and reporting it as a federal subsistence moose.

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Table 1 Unit 11 Moose composition counts in Count Area 11, 1996–2001

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour	Density ² moose/mi ²
1996	92	11	21	10	121	134	30	0.5
1997	128	4	9	4	107	111	29	0.4
1998	111	9	15	7	97	104	24	0.4
1999	109	11	21	9	111	122	28	0.4
2000	157	3	24	9	95	104	23	0.4
2001	94	4	9	4	89	93	19	0.3

Table 2 Unit 11 Moose harvest^a and accidental death, 1996–2000

Year	M	Reported F	Total ^b	Unreported	Estimated Illegal	Total	Total
1996	38	0	38	5	5	10	48
1997	34	0	34	5	5	10	44
1998	27	0	28	5	5	10	38
1999	38	0	40	5	5	10	50
2000	45	0	45	5	5	10	55

^a Includes state harvest tickets and federal registration permit hunts.

^b Includes unknown sex.

Table 3 Unit 11 Moose hunter residency and success for general state harvest ticket hunt only, 1996–2000

Year	Successful				Unsuccessful			
	Local resident	Nonlocal resident	Non Resident	Total ^a	Local resident	Nonlocal resident	Non-resident	Total ^a
1996	18	15	5	38	53	6	2	62
1997	28	3	3	34	48	26	4	79
1998	18	8	2	28	65	13	1	80
1999	25	9	6	40	37	41	4	83
2000	13	8	4	30	35	40	4	80

^a Includes unspecified residency.

Table 4 Unit 11 Moose harvest (%) chronology by seasonal weeks for general state harvest ticket hunt only, 1996–2000

Year	Season Dates	Week of Season				
		1st	2nd	3rd	4th	5th
1996	20 Aug–20 Sep	5	8	11	54	22
1997	20 Aug–20 Sep	3	3	9	23	62
1998	20 Aug–20 Sep	0	4	22	41	33
1999	20 Aug–20 Sep	14	11	8	30	38
2000	20 Aug–20 Sep	7	3	10	27	53

Table 5 Unit 11 Successful moose hunter transport methods (%) for general state harvest ticket hunt only, 1996–2000

Year	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unknown
1996	21	10	3	26	3	8	26	3
1997	21	6	0	26	0	12	21	15
1998	29	0	0	32	0	7	25	7
1999	33	0	3	33	0	8	23	3
2000	47	0	0	27	0	7	17	3

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 12 (10,000 mi²)

GEOGRAPHIC DESCRIPTION: Upper Tanana and White River drainages

BACKGROUND

Following federal wolf control, the Unit 12 moose population irrupted during the 1950s through the mid-1960s. Moose numbers declined rapidly during the early 1970s, similar to populations in adjacent road accessible areas. Several severe winters, high wolf and grizzly bear predation, and high localized cow moose harvests all contributed to the population decline. Cow moose hunts were stopped after 1974, and the Nabesna Road moose season was closed entirely from 1974 through 1981. Between 1986 and 1991, the Little Tok River drainage was closed to moose hunting because of low yearling recruitment and a declining bull:cow ratio. Between the mid1970s and early 1980s, the Unit 12 moose density was estimated between 0.2 and 0.4 moose/mi² (ADF&G, unpublished data).

In response to the declining moose populations, wolf control programs were conducted in adjacent Units 20D (1980), 20E (1981–1983), and northern Unit 12 (1981–1983). Beginning in regulatory year (RY) 1982, which begins 1 July and ends 30 June (e.g., RY82 = 1 Jul 1982–30 Jun 1983), attempts were made to reduce the grizzly bear population by liberalizing harvest regulations. Moose habitat enhancement programs were conducted during the late 1980s and again in 1997. Between 1982 and 1989 the moose population in Unit 12 increased, probably due to a combination of these management programs and favorable climatic conditions that prevailed during this period. However, the population remained at low density (0.4–0.6 moose/mi²).

Unit 12 has been an important moose hunting area for local residents, hunters from Southcentral Alaska, and guided nonresidents. It is also an important wildlife viewing area for tourists driving the Alaska Highway. The Upper Tanana Valley is the first area in Alaska visited by thousands of highway travelers who are here to view Alaska's wildlife. During the 1960s when the Unit 12 moose population was high, hunting seasons and bag limits were liberal and hunter participation and success were high. Moose were commonly viewed while traveling the area's highways. During that period, needs of consumptive and nonconsumptive users were met. Since the unit's moose population declined to a low level, the hunting season

and bag limit have become restrictive and harvest has declined by over 40%. Moose watching has also declined and few tourists observe moose while traveling through Unit 12.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population in concert with other components of the ecosystem.
- Continue sustained opportunities for subsistence use of moose.
- Maximize sustained opportunities to participate in hunting moose.
- Maximize opportunities for the nonconsumptive use of moose.

MANAGEMENT OBJECTIVE

- Maintain a minimum posthunting sex ratio of 40 bulls:100 cows east of the Nabesna River and a minimum ratio of 20 bulls:100 cows in the remainder of the unit.

INTENSIVE MANAGEMENT OBJECTIVES

- Population: 4000–6000 moose
- Harvest: 250–450 moose annually

METHODS

POPULATION ESTIMATION AND COMPOSITION SURVEYS

We estimated the moose population size in 1120 mi² in northwestern Unit 12 during November 1994 and October 1997. Methods followed standard Gasaway survey techniques (Gasaway et al. 1986), except the areas were stratified using historic count data collected during aerial contour counts or population estimation surveys. The area in northwestern Unit 12 was divided into 34 high density and 42 low/medium moose density strata sample units in 1994. Based on 1994 and 1996 survey results we restratified the area into 37 high and 39 low/medium strata sample units in 1997. We flew 24 random sample units (16 high; 8 low/medium) covering approximately 32% of the study area during 1994 and 27 random units (19 high; 9 low/medium) covering 37% of the area during 1997. Standard search intensity was about 4.25 min/mi² in 1994 and 3.45 min/mi² in 1997. Portions of 12 sample units (1994; 8 highs, 4 lows) and 14 units (1997; 9 highs, 5 lows) were resampled at a search intensity of 12 min/mi² to determine a sightability correction factor.

During 2000 and 2001, in cooperation with Tetlin National Wildlife Refuge staff, we estimated moose population size and composition using a spatial correlation technique (Ver Hoef 2001) in all of Unit 12 excluding portions of the Nabesna, Chisana, and White River drainages within Wrangell–St. Elias National Park and Preserve. All moose habitat in this area was divided into high (≥ 2 moose/sample area) or low (< 2 moose/sample area) strata.

During each year, between 60–65% of the sampled areas were high strata. All moose observed were classified as either large bulls (antlers >50 inches), medium bulls (antlers larger than yearlings but <50 inches), small bulls (spike, cerviform, or palmate-antlered [no brow separation] yearling bulls), cows, calves, or unidentified moose.

The National Park Service (NPS) conducted a “no-strat” population estimation survey (Dale et al. 1994) in a 352-mi² area in the vicinity of Chisana in southeast Unit 12 during October 1998 (NPS, Wrangell–St Elias National Park and Preserve, unpublished data).

We conducted aerial composition surveys in October and November 1993–1999 in 4–9 traditional trend count areas. All moose observed were classified as either large bulls (antlers >50 inches), medium bulls (antlers larger than yearlings but <50 inches), small bulls (spike, cerviform, or palmate-antlered [no brow separation] yearling bulls), cows without calves, cows with 1 calf, cows with 2 calves, lone calves, or unidentified moose. These data were used to estimate population and composition trends by comparing moose observed per hour and composition ratios between years.

HARVEST

Harvest was estimated using harvest report cards with the benefit of reminder letters to hunters who did not initially report. Information obtained from the reports was used to determine total harvest, hunter residency and success rates, harvest chronology, and transportation used. Harvest data were summarized by regulatory year. Estimates of potlatch take are obtained by interviewing residents and public safety officers of villages where potlatches have taken place.

HABITAT ENHANCEMENT

We made significant progress on developing a cooperative wildlife habitat logging plan with the Department of Natural Resources/Division of Forestry designed to increase the amount of deciduous browse and cover for wildlife and to provide nursery structure for planted spruce seedlings. The Robertson River Prescribed Burn Plan was completed and should be implemented during summer 2002.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Based on data collected during annual October/November aerial composition surveys and 7 area-specific population estimation surveys (1989, 1990, 1994, 1997, 1998, 2000, and 2001), the moose population in Unit 12 increased slowly from 1982–1989 and remained relatively stable from 1989–1993. Increased calf survival allowed the Unit 12 population to grow slightly during 1994–1997. The population remained stable during 1998–2001. During the growth phase in 1994–1997, the most apparent increase occurred in the northwest portion of the unit within the area affected by the 1990 Tok wildfire (155 mi²). Population estimates

indicate this area supported 0.19 moose/mi² in 1989 but increased to 0.6 moose/mi² by 1994 and about 1.0 moose/mi² in 1997.

The 1999 estimated population range was 3500–4000 moose using results from past year's population estimates and composition surveys conducted in 1999. The 2001 Unit 12 population estimate was 3450–4300 moose ($\pm 16\%$, 90% CI). The estimated density was 0.6–0.7 moose/mi² of suitable moose habitat (6000 mi²).

Localized moose harvest caused declines in moose numbers near the villages and communities in Unit 12. Poaching and taking moose for funeral and ceremonial potlatches have had the greatest effect because cow moose were harvested most. The current Fish and Wildlife Protection officer conducted intensive public awareness campaigns explaining the limiting effects of poaching on local moose numbers. His efforts resulted in a noticeable reduction in the number of poaching cases. We tried to work with the local villages to improve potlatch moose harvest reporting and to develop a strategy that would meet cultural needs but limit the harvest to more sustainable levels. We have been largely unsuccessful. The villages were very willing to report when they were going to hunt for a potlatch, which reduced confusion during periods when hunting season was not open. However, reporting following the potlatch remained poor and total take and cow harvest has not declined.

On 11 and 12 June 2001, elders from Northway (Alaska) and Beaver Creek (Yukon, Canada) villages met to discuss fish and wildlife issues as part of a traditional workshop. Potlatch moose harvest and its effects on moose population trend were discussed. The elders decided the best course of action was to conduct meetings in each village and discuss the cultural values and needs of potlatches, historic harvest practices, and current moose population trend. These meetings were scheduled for July 2002.

The Alaska Board of Game identified the moose population within Unit 12 as important for high levels of human consumptive use under the Intensive Management Law (AS 16.05.255[e]–[g]). This designation means the board must consider intensive management if regulatory action to significantly reduce harvest becomes necessary because the population is depleted or has reduced productivity. The board set the Unit 12 population objectives at 4000–6000 moose and harvest objectives at 250–350 moose. The Unit 12 moose population is at the lower end of the population objective, but calf survival is not high enough to allow the harvest objective to be met. Based on modeling the trends of the Unit 12 moose population and hunter participation and harvest, harvest needs to be maintained at 130 bulls and distributed throughout the unit to protect the bull population, especially in the more accessible areas of the unit. Significantly increasing the moose population and the sustainable harvest will require intensive management to reduce the effects of wolf and bear predation.

To better evaluate the potential outcome of different intensive management programs on the Unit 12 moose population, I modeled current population status and trend data for moose and their predators using the McNay and DeLong (1998) Predprey model. Past research found that predation by both wolves and bears was the primary factor maintaining the area moose populations at low densities (0.2–1.0 moose/mi², Gasaway et al. 1992; US Fish and Wildlife Service, unpublished data). The effects of wolves and bears vary among areas within Unit 12. In the Northway and Tetlin Flats, both calf mortality and predation rate studies indicated that

wolves were the primary predator on calves and adult moose throughout the year. In contrast, along the Nutzotin Mountains, calf recruitment to 5 months was substantially lower and was more indicative of grizzly bear predation. Modeling exercises using actual moose composition and predator kill rate data indicated the Unit 12 moose population continued to be primarily limited by wolves although grizzly bears were an important predator in portions of the unit. Model results also indicated the Unit 12 moose population will remain at low densities for an extended period of time with little opportunity for increased harvest if predation levels remain the same.

Assuming grizzly bear predation rates remain relatively constant during the next 5 years, the model predicted the Unit 12 moose population would increase substantially if unit wolf numbers were reduced. A wolf population reduction of 80% was found to have caused moose and caribou populations to increase ($\lambda \geq 1.15$) in other areas of Alaska and Yukon (Boertje et al. 1996). If the unit's wolf population is controlled at this level, the modeled moose population increases at 8–14% annually. However, wolf control is not an option on federal lands, which constitute a majority of Unit 12. If wolf control is conducted only on state and private lands, the modeled moose population increases at about 6–9%. Because wolves are the primary predator in most of Unit 12, regulating wolf numbers by public trapping can also benefit moose. If trappers remove 40% of the fall population each year, wolf numbers would decline allowing the moose population to increase 4–5% annually.

Because the moose population in the northwest portion of the unit increased as a result of the 1990 Tok wildfire and as a result of intense public hunting and trapping of predators, other local moose population increases could possibly occur in Unit 12 without government wolf control. These moose population increases would be moderate and would be eventually limited by predation. However these population increases would be enough to satisfy the minimum intensive management objectives. Because of landownership patterns in Unit 12, this will be the management direction taken during the next 5 years.

Population Composition

We conducted moose composition surveys in Unit 12 during fall 1988–2001 (Table 1). Composition data since 1994 are not directly comparable with previous years because sampling techniques changed. Prior to 1994, trend count areas within the Tok, Little Tok, Tetlin, Nabesna, and Chisana Rivers were surveyed annually. During 1994, 1997, 2000, and 2001, we conducted population estimation surveys over a much larger area which included the traditional count areas. During 1995, 1996, 1998, and 1999, a portion of the trend count areas were surveyed to protect against missing a catastrophic decline in the area's moose population during years population estimation surveys were not conducted. Benefits of conducting population estimation surveys included confidence limits around composition estimates and, because more area and habitats were sampled, it was less likely that weather or moose distribution anomalies would affect the count. We found calf:cow ratios were lower within the high strata compared to low strata, indicating that most calf:cow pairs select for habitats not normally surveyed during trend counts. Most of the trend count areas were located within high-density areas to optimize the number of moose surveyed.

During 2000 and 2001, Tetlin National Wildlife Refuge staff cooperated with us to design moose surveying areas to obtain population and composition estimates for most of Unit 12. This cooperation will continue at least 2 more years.

During 2000 and 2001, bull:cow ratios ranged from 40:100 in western and northern portions of Unit 12 to 64–84:100 in the eastern and southern portions. Most harvest occurred in the western and northern portions of the unit and in some areas caused the bull:cow ratio to decline. Within the Tok River drainages and along the north side of the Alaska Range, the bull:cow ratio declined to 22–26:100 from the low 30s:100 during the mid-to-late 1990s but has remained relatively stable since 1999. The Unit 12 bull:cow ratio remains above the population objective.

Annually, 45–50% of the total Unit 12 moose harvest occurred in the Tok River drainage and along the Front Range. Yearling bull recruitment ranged from 7–11:100 and was not adequate to compensate for harvest. The bull:cow ratio stabilized during RY99–RY01 because hunting success rate declined probably because bull density became so low.

In 1999 calf survival to 5 months was low (17–23:100 cows) in Unit 12 and adjacent areas in Units 20D and 20E. Calf survival was also low in western and northern Unit 12 (18:100) and in southern Unit 20E (14–21:100) during 2000. In central and eastern Unit 12 the 2000 calf:cow ratio was 34:100. Unit 12 calf:cow ratios were 27–33:100 in 2001. The number of calves surviving to 5 months compared to the number of yearling bulls (9–14:100) during the report period suggests that wolves continue to be a primary predator in Unit 12.

Distribution and Movements

Moose live throughout Unit 12 below an elevation of about 4500 feet. There is about 6000 mi² (15,540 km²) of suitable habitat. There are both migratory and sedentary populations. Moose that rut in the Tok River area appear to move the greatest distances. Many cows migrate as far south as the Gakona River for calving, return to the Tok River for the rut, and then move north to the area burned by the 1990 Tok wildfire or to the Tanana River to winter, a straight line distance of 90–100 miles (144–160 km). In route to the Tok wildfire area during winters 1999–2001, 10–30 moose were consistently observed using an area along the Tok River that was mechanically crushed in 1998.

Moose distribution in Unit 12 changed over the past 10 years. During RY99–RY00, very few resident moose existed on the Northway Flats, in the vicinity of Tanacross, or north of Tok along the Tanana River. Year-round poaching and harvest for funeral or ceremonial potlatches contributed to the decline of resident moose in these lowland areas near human settlements. Also, some of these moose may now be spending more time in the 1990 Tok River burned area. Moose use of the Tok River valley and the Tetlin Hills increased substantially since 1989. Densities increased from 0.19 moose/mi² (1989) to about 1 moose/mi² (1997–2001). Use of this area by moose occurred throughout the year. Increased use of this area was a result of improved habitat from the 1990 Tok River fire and moderate harvests of predators.

MORTALITY

Harvest

Season and Bag Limit. Seasons and bag limits in Unit 12 were as follows:

RY99–RY00

Units and Bag Limits	Resident Open Season	Nonresident Open Season
1 bull with spike-fork antlers.	15 Aug–28 Aug	No open season
Unit 12, that portion drained by the Little Tok River upstream from and including the first eastern tributary from the headwaters of Tuck Creek. RESIDENT AND NONRESIDENT HUNTERS: 1 bull with spike- fork antlers or 50-inch antlers or antlers with 4 or more brow tines on 1 side.	1 Sep–15 Sep	5 Sep–15 Sep
Unit 12, that portion lying east of the Nabesna River and south of the winter trail running southeast from Pickeral Lake to the Canadian border. RESIDENT AND NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.	1 Sep–30 Sep	1 Sep–30 Sep
Remainder of Unit 12. RESIDENT HUNTERS: 1 bull. NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.	1 Sep–15 Sep	5 Sep–15 Sep

RY01

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 12, that portion drained by the Little Tok River upstream from and including the first eastern tributary from the headwaters of Tuck Creek. RESIDENT AND NONRESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on 1 side.	24 Aug–28 Aug 8 Sep–17 Sep	8 Sep–17 Sep
Unit 12, that portion lying east of the Nabesna River and south of the winter trail running southeast from Pickeral Lake to the Canadian border. RESIDENT AND NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.	1 Sep–30 Sep	1 Sep–30 Sep
Remainder of Unit 12. RESIDENT HUNTERS: 1 bull. NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.	24 Aug–28 Aug 8 Sep–17 Sep	8 Sep–15 Sep

Alaska Board of Game Actions and Emergency Orders. During the spring 2000 meeting, the Alaska Board of Game split the moose season into 2 periods: 24–28 August and 8–17 September except east of the Nabesna River and south of the winter trail running southeast from Pickerel Lake to the Canadian border where the season remained 1–30 September. After creating the 5-day August season for any bull, the 14-day spike/fork-only August season was eliminated. Also in spring 2000, the board established population objectives for Unit 12 at 4000–6000 moose and harvest objectives at 250–450 moose.

Hunter Harvest. Reported harvest in Unit 12 was 137 bulls and 2 unknown sex in RY99, 112 bulls in RY00, and 99 bulls and 1 unknown sex in RY01 (Table 2). The 5-year average reported moose harvest was 121. The number of hunters and harvest increased in 1995.

Average annual harvest during 1990–1994 was 92 compared to 121 (32% increase) during 1995–2001.

During RY99–RY01 the highest number of hunters (186–207) and the greatest harvest (40–49) occurred in the Tok River valley. The other most intensively hunted area was between the Robertson River and Northway along the Alaska Highway or Tanana River. That area was hunted by 95–111 hunters and 9–19 bull moose were taken. Local residents have historically hunted these areas. During RY99–RY01, local residents comprised 42–55% of the hunters and took 39–45% of the harvest in the Tok River and 67–81% of the hunters took 67–89% of the harvest along the Tanana River and Alaska Highway. Hunter composition changed in the Tok River area as more nonlocal Alaskan residents hunted the Tok River drainage. The number of local residents and nonresidents using this area remained consistent during RY96–RY01. Since enacting antler size restrictions in RY93, harvest within the Little Tok River drainage declined to an average of 5 per year during RY94–RY01 compared to 10 and 20 bulls per year during RY91 and RY92.

Reported harvest represented about 2.5–3.5% of the prehunt Unit 12 population and had little impact on population dynamics. During RY99–RY01 the annual out-of-season take for funeral or ceremonial potlatches was 25–50 moose of either sex. Most of the potlatch harvest was comprised of cow moose. During the early 1990s this harvest was probably as high as 60 moose annually because poaching was more of a problem and additive to the potlatch take. Most out-of-season harvest occurred near communities and along the road system. Thus, the annual Unit 12 harvest was probably closer to 4–5.5% of the population. Under this harvest rate and these harvest distribution patterns, the moose population around Unit 12 villages and communities continued at low levels.

During RY99–RY01, antler size was reported for 125, 112, and 95 harvested bulls, and the average size was 45.0, 46.4, and 47.4 inches. The 5-year average (RY97–RY01) was 46.1 inches compared to the 45.5 inches during RY92–RY96. Of the 112 bull moose harvested in Unit 12 during RY00, 19 bulls (17%) were judged to be yearlings (antlers <30 inches), 47 (42%) were 2–4 years old (antler spread 30.0–49.9 inches), and 46 (41%) were mature bulls (antler spread ≥50 inches). Antler spreads were estimated for 145 bulls observed during population estimation surveys during October and November 2000 after the hunting season. Of these, 23% were yearlings, 51% were 2–4 year olds, and 26% were mature bulls. The apparent selection for mature bulls in the harvest can be explained in that 65% of the mature bulls were taken because of regulation requirements either by nonresidents or by residents hunting in antler restriction areas.

In most years, yearling bulls were underrepresented in the harvest. Based on conversations with many local hunters it is apparent that yearling bull moose movements and behavior patterns allow this age class to avoid hunters. Hunters were not passing up yearling bulls in favor of larger bulls.

Hunter Residency and Success. During RY99–RY01, local residents accounted for an average of 56%, nonlocal residents averaged 36% and nonresidents 8% of the moose hunters in Unit 12. Compared to RY94–RY98, these percentages changed due to an increase (23%) in the number of nonlocal Alaska residents that hunted Unit 12. The number of local and

nonresident hunters remained relatively constant since RY94. Local hunters harvested 44 to 49% of the reported harvested bulls during RY99–RY01, nonlocals took 27 to 37%, and nonresidents 19 to 22% (Table 3). Local harvest ranged between 42–50% and nonlocal harvest between 27–38%, since RY94. The higher than expected success for nonresidents in Unit 12 was because most ($\geq 77\%$) were guided.

During RY99–RY01, 520–557 hunters reported hunting moose in Unit 12 (Table 3). The 5-year average was 520 compared to the average of 466 between RY92–RY96, a 12% increase. Increased participation by nonlocal Alaska residents mostly from Southcentral Alaska accounts for a majority of the increase in hunters. This trend also occurred in adjacent Unit 20E. During RY99–RY00, the average success rate was 22% compared to 23% during RY94–RY98.

Harvest Chronology. During RY91–RY00, an average of 33 bulls were harvested during 1–6 September (Table 4) representing 30% of the fall harvest (range = 27–35%). In an attempt to maintain or reduce the fall harvest in Unit 12, during RY01 the hunting season in most of the subunit was split into 2 periods: 24–28 August and 8–17 September. Our intent was to decrease total harvest. During RY93–RY00, 18–36 ($\bar{x} = 27$) bulls were harvested during 1–5 September. In RY01, 9 bulls were harvest during 24–28 August. During the first year under this regulation, harvest was reduced 50–69% during the first 5 days of the season. This reduction in harvest was not regained during the 10-day September season. The RY01 harvest was 19% lower than the average harvest during RY96–RY00.

The number of hunters who used the 1–30 September season in southern Unit 12 and the total harvest for this season remained similar to past years. Most of these hunters were guided nonresidents or Chisana residents.

Transport Methods. During RY99–RY01, the transportation type used by most hunters, on average, was highway vehicles (35%), followed by 4-wheelers (23%), boats (16%), other ORVs (9%), airplanes (7%), and horses (4%). Method of transport was unknown for 6% of the hunters. Compared to RY94–RY98, more hunters used 4-wheelers (34% increase) and fewer highway vehicles as transportation. Use of all other transportation types remained relatively constant. Hunters using highway vehicles had the lowest average success rate (14%), but traditionally, until RY00, took the greatest number of moose annually (Table 5).

During RY00 and RY01, hunters using 4-wheelers took the greatest number of moose. Hunters using horses had the highest success rate (54%). Horses were primarily used by guides to transport nonresident hunters into the most remote sections of the unit. Hunters using airplanes had a success rate of 45% during the past 8 years. Success rates for hunters using 4-wheelers (23%), ORVs (26%), or boats (25%) were similar and were near the unit's average success rate.

Other Mortality

Predation by wolves and grizzly bears has been the greatest source of mortality for moose in Unit 12 and has maintained the population at a low density (0.4–0.7 moose/mi²) since the mid-1970s. In contrast with most other areas that contain sympatric moose, wolf, and grizzly

bear populations, wolves, rather than bears, were the primary predator on moose calves on the Northway–Tetlin Flats, based on research conducted during the late 1980s (ADF&G unpublished data; US Fish and Wildlife Service, unpublished data). Wolf predation also appeared to be the greatest source of adult mortality. However, in some mountainous areas of Unit 12, fall composition data indicate that predation on moose neonates was high, suggesting grizzly bear predation.

In much of Unit 12 the grizzly bear population is stable at a food-limited density that is typical for Interior Alaska bear populations (16–20 bears/1000 km²). The grizzly bear population probably declined in portions of the unit since the mid-1980s due to increased harvest by hunters.

Wolf populations increased in Unit 12 at least since 1989 when tens of thousands of Nelchina caribou started to spend the winter in or migrate through Unit 12. Between 1989 and 1992, the fall Unit 12 wolf population increased 30–40%, and during 1992–1993 there were 230–243 wolves in a minimum of 28 packs.

During RY92 and RY93, the wolf population declined in Unit 12 due to increased harvest by trappers (Gardner 2000a). The estimated decline within the unit was about 25%, but most of the decline occurred within the western portion of the unit where over 40% of the total harvest occurred and the estimated wolf population decline was 30–40%. Wolf harvest declined substantially (13–24% harvest rate) in RY94 through RY00 due to low pelt prices. The wolf population subsequently increased about 30% during those years and in RY00 was estimated to be 230–245 wolves.

Considering the population status and trends of wolves and grizzly bears in Unit 12, I expect the moose population to remain at low density (0.2–1.0 moose/mi²) for an extended period. However, it appears that concentrated public wolf trapping and bear harvest can cause local populations of moose to increase, especially in areas that received habitat enhancement. The likely mechanism is improved calf and yearling survival. Adult mortality probably changes little. Modeling data and survey data support this hypothesis.

HABITAT

Assessment

Only about 6000 mi² in Unit 12 are moose habitat. However, excessive wildfire suppression for nearly 30 years allowed vast areas of potentially good moose habitat to become choked with spruce forests that lack high-quality deciduous moose browse. We conducted browse surveys periodically the past 15 years and found that in most years use of preferred browse species is low in relation to availability. During deep snow winters, moose concentrated in areas along the Tok and Tanana Rivers and the browsing rate was much higher. In all years, disturbed sites with early successional species were used far more heavily than adjacent undisturbed areas. During RY99–RY01 habitat was not limiting the moose population in Unit 12 but medium to large scale creation of early seral species could cause the moose population to increase, as evidenced by the 1969 Ladue burn in eastern Unit 20E (Gardner

2000b), the 1990 Tok burn, and the Teslin burn in the Yukon (Boertje et al. 1995). Boertje et al. (1995) hypothesized that seral stages reduce predation efficiency in a variety of ways.

Enhancement

During the 1980s, over 1800 acres of old age, decadent willows were intentionally disturbed to stimulate crown sprouting of new leaders. Using data collected during our browse surveys, we estimated that these habitat enhancement projects produced over 2 million pounds of additional browse each year for wintering moose. In eastern Unit 12 the US Fish and Wildlife Service completed several prescribed fires to benefit moose on the Tetlin National Wildlife Refuge.

In 1997 we mechanically crushed 275 acres of decadent willow and aspen within the Tok River valley to stimulate crown growth. We conducted informal surveys in this area during summers 1999 and 2001 and found extensive stands of feltleaf willow (*Salix alaxensis*) and red-stem willow (*Salix planifolia*), preferred moose browse species. In summer 2001 most of the shrubs were between 3–10 feet; <1% were above 10 feet and unavailable for moose. We documented continual use of this area during the winter by 10–30 moose and observed increased use as calving habitat.

Since 1998 we have been working in cooperation with the Division of Forestry to determine suitable logging sites within a proposed 1000-acre timber sale area in the Tok River valley. Potential cut areas are selected based on numbers of marketable trees, historic winter moose use, and the potential to regenerate quality moose browse species. In addition we are assisting in designing and implementing scarification techniques that will promote willow and aspen regeneration following logging on these sites. Cut areas will be 80–200 acres in size. Logging should begin during winter 2002–2003.

From June to September 1990, a wildfire burned approximately 97,000 acres of primarily decadent black spruce muskeg in the Tetlin Hills and adjacent Tok River lowlands. Quality moose browse species recolonized much of this area and, in response, the area's moose population increased rapidly (0.19 moose/mi² in 1989 to 1.0 moose/mi² by 1997). Excellent moose winter browse supplies are expected to exist for the next 15–20 years.

Local residents observed the increase in moose in the area burned by the 1990 Tok wildfire. As a result, more residents, including Natives, are more receptive to using fire or other habitat enhancement techniques to benefit moose, as evidenced by planned prescribe burns in the Robertson River in 2002 and near Tanacross village in 2003.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

If moose numbers are to increase along the road system in Unit 12, the number of cow moose taken for ceremonial and funerary potlatches must decline. The department tried to address this problem with local villages during village council meetings and Traditional Knowledge workshops but no corrective steps were taken. The local Upper Tanana/Fortymile Advisory Committee requested the Board of Game address the issue, and the Division of Wildlife Protection submitted a proposal to correct one element of the potlatch harvest issue but the board tabled the issued until 2003. Potlatches are culturally important and should be

maintained but restrictions on harvest, especially in areas like Unit 12 where the moose densities are very low, should be implemented. During summer 2002 we will work with Northway village residents to design potlatch moose management that better protects the moose population and still meets the village's needs. Results of this meeting will be presented in the next management report.

CONCLUSIONS AND RECOMMENDATIONS

During RY99–RY01 moose were far less numerous in Unit 12 than in the 1960s. The population declined rapidly during the 1970s, increased during the late 1980s, stabilized or slightly declined from 1989–1993, increased slightly from 1994–1996, and remained stable from 1997–2001. Moose numbers, especially in the vicinity of the road system, were very low which primarily affected subsistence hunters and nonconsumptive users. Every year hundreds of Alaska Highway travelers commented on the lack of wildlife in the Upper Tanana Valley. Habitat was not limiting, but predation and out of season funeral and ceremonial take in certain areas maintained the moose population at low density. Between 1991 and 1997 the moose population increased within the area affected by the Tok wildfire. Residents of Tetlin and Tok and a growing number of nonlocal residents increased their hunting of the area and consequently legal and out-of-season harvest stabilized moose population growth.

In more accessible areas of Unit 12 the bull:cow ratio declined to 20–25:100 due to moderate harvest rates and low yearling bull recruitment. In the Little Tok River, an antler restriction regulation was adopted in an attempt to protect the bull:cow ratio, but still allow maximum hunter opportunity. Harvest may need to be restricted in a similar manner in the Tok River drainage and along the north face of the Alaska Range because of high harvest rates.

During RY96–RY01, the number of hunters increased by 12% and harvest increased by 32% compared to RY91–RY95. However, in RY01 when the Unit 12 moose season was split into a 5-day August season for any bull and a 10-day mid-September season for any bull, harvest declined by 19% compared to the average annual harvest during RY96–RY00.

The Alaska Board of Game established population objectives for Unit 12 at 4000–6000 moose and harvest objectives at 250–450 moose. The 2001 population was at or just below the population objective but was not productive enough to maintain the desired harvest. Modeling indicated intensive management objectives could be met in portions of the unit if intensive habitat management was coupled with elevated public wolf and bear harvest.

Other than the intensive management harvest objective, the Unit 12 moose goals and objectives were met during RY99–RY01. Population trends were monitored. Additional habitat enhancement programs were planned and should be implemented during the next 2 years. Hunting seasons and bag limits were established that allowed maximum hunting opportunity and met subsistence needs. We are continuing to work with local villages to reduce potlatch take, especially of cow moose. Moose watching opportunities were shared with visitors and local residents, and several presentations were given to local schools and tourist groups annually.

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Table 1 Unit 12 aerial moose composition counts, fall 1988–2001

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/hr
1988	64	18	33	189	17	943	1133	40
1989 ^a	50	13	30	223	17	1094	1317	44
1990	47	12	25	185	15	1071	1256	40
1991	49	12	24	200	14	1264	1472	44
1992	45	10	26	165	15	906	1071	32
1993 ^b	26	7	36	187	22	662	850	57
1994 ^c	38	16	39	87	21	327	414	
1994 ^d	97	13	25	47	11	374	421	44
1995 ^d	82	12	26	65	12	461	526	51
1996	39	9	32	236	19	1022	1258	57
1997 ^c	36	11	41	138	23	458	596	
1997 ^d	87	22	31	73	14	439	512	39
1998 ^e	65	14	34	48	17	229	277	
1998 ^f	38	7	29	26	17	124	150	54
1999 ^b	22	8	17	102	12	721	823	65
2000 ^{g,i}	40	9	18		12		630	
2000 ^{h,i}	84	10	34		15		268	
2001 ^{g,i}	40	11	27		16		672	
2001 ^{h,i}	64	18	33		17		466	

^a Tok and Dry Tok were not surveyed. These survey areas normally yield a sample of 400+ moose.

^b Cheslina and the northern face of the Nutzotin Mountains were not surveyed. These survey areas normally have about 100 bulls:100 cows.

^c Based on population estimation results from northwestern Unit 12.

^d Cheslina, Kalukna, Nabesna, and Chisana count areas were sampled using contour survey techniques.

^e Based on population estimation results from the Chisana area, southwest Unit 12 using the “No-strat” technique.

^f Only the north face of the Alaska Range sampled using the contour survey technique.

^g Survey area includes state and private lands in western and northern Unit 12.

^h Survey area includes federal and private lands in eastern and southern Unit 12.

ⁱ Ratios determined using weighted contributions from high and low sample areas. Actual counts of cows, calves and bulls were not used in estimates.

Table 2 Unit 12 moose harvest and accidental death, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest by hunters									Accidental death		
	Reported						Estimated			Road		Total
	M (%)		F (%)		Unk	Total	Unreported	Illegal	Total		Total	
1990–1991	94	(96)	0	(0)	4	98	15–20	30–40	45–60	4–5	4–5	147–163
1991–1992	109	(99)	0	(0)	1	110	15–20	30–40	45–60	4–5	4–5	159–175
1992–1993	71	(100)	0	(0)	0	71	15–20	30–40	45–60	4–5	4–5	120–136
1993–1994	91	(100)	0	(0)	0	91	15–20	30–45	45–65	5–7	5–7	141–163
1994–1995	87	(100)	0	(0)	1	88	15–20	30–45	45–65	7	7	140–160
1995–1996	117	(100)	0	(0)	1	118	20–25	5–10	25–35	3–5	3–5	146–158
1996–1997	124	(100)	0	(0)	0	124	20–25	3–10	23–35	3–5	3–5	150–164
1997–1998	102	(100)	0	(0)	0	102	20–25	3–10	23–35	3–5	3–5	128–142
1998–1999	148	(99)	1	(1)	0	149	20–25	3–10	23–35	3–5	3–5	175–189
1999–2000	137	(99)	0	(0)	2	139	20–50	3–10	23–60	3–5	3–5	165–204
2000–2001	112	(100)	0	(0)	0	112	20–50	3–10	23–60	3–5	3–5	138–177
2001–2002	99	(98)	0	(0)	2	101	20–50	3–10	23–60	3–5	3–5	127–166

Table 3 Unit 12 moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Total (%)	
1990–1991	45	26	17	98 (23)	186	131	15	332 (77)	430
1991–1992	48	49	13	110 (27)	160	132	9	305 (73)	415
1992–1993	23	35	12	71 (15)	222	164	13	408 (85)	479
1993–1994	38	33	18	91 (24)	186	90	12	289 (76)	380
1994–1995	43	28	17	88 (19)	240	118	15	374 (81)	462
1995–1996	55	34	26	118 (24)	249	113	16	378 (76)	496
1996–1997	62	41	20	124 (24)	251	119	14	384 (76)	512
1997–1998	43	29	30	102 (21)	245	125	14	384 (78)	492
1998–1999	68	46	35	149 (29)	232	110	19	361 (71)	510
1999–2000	69	41	29	139 (25)	240	155	23	418 (75)	557
2000–2001	49	41	21	112 (21)	241	144	23	409 (79)	521
2001–2002	49	27	22	101 (19)	242	155	20	419 (81)	520

^a Residents of Units 12 and Units 20E and eastern 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.

^b Total may include hunters who did not specify whether or not they were residents.

Table 4 Unit 12 moose harvest chronology by month/day, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest chronology by month/day						Total ^a
	8/15–8/28	9/1–9/6	9/7–9/13	9/14–9/20	9/21–9/27	9/28–10/5	
1990–1991		18	41	28	4	3	98
1991–1992		34	45	22	4	1	110
1992–1993		25	31	6	4	4	71
1993–1994		29	40	16	4	0	91
1994–1995		25	26	25	3	4	88
1995–1996	2	33	52	17	5	6	118 ^b
1996–1997	1	39	44	27	7	1	124 ^b
1997–1998	1	30	38	19	10	1	102
1998–1999	2	41	65	30	5	1	149
1999–2000	11	37	54	23	3	2	139
2000–2001	4	32	48	16	6	2	112
2001–2002	9	0	41	34	6	4	101

^a Difference between total and summation of harvests by week represents moose taken on unknown dates.

^b One moose was taken during a federal hunt in November 1995.

Table 5 Unit 12 moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
1990–1991	17	15	21	11	0	6	23	5	98
1991–1992	10	14	10	25	0	14	25	2	110
1992–1993	18	23	10	11	0	10	28	0	71
1993–1994	8	19	15	22	0	16	18	2	91
1994–1995	10	20	19	18	0	7	23	2	88
1995–1996	10	13	28	17	0	6	22	4	118
1996–1997	13	9	22	19	0	7	28	2	124
1997–1998	15	21	16	20	0	3	24	1	102
1998–1999	16	12	17	20	0	11	22	1	149
1999–2000	12	9	16	22	0	12	27	2	139
2000–2001	14	10	19	24	0	12	20	2	112
2001–2002	15	10	20	31	0	9	16	0	101

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
JUNEAU, AK 99802-5526

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 13 (23,376 mi²)

GEOGRAPHIC DESCRIPTION: Nelchina and Upper Susitna Rivers

BACKGROUND

Moose densities in Unit 13 were low during the early 1900s, but started to increase by the 1940s. Moose were abundant throughout the 1950s, and the population peaked in the mid 1960s. For the next 10 years, moose numbers declined and reached a population low by 1975. Factors contributing to the decline were severe winters, increased predation, and large human harvests of both bulls and cows. The number of moose counted during fall surveys started to increase in 1978 and climbed at an average annual rate of 5% until 1987, when the population peaked again. Moose numbers started to decline again during the early 1990s because of a series of severe winters and increased predation.

Historically, Unit 13 has been an important area for moose hunting in Alaska. Annual harvests were large, averaging over 1200 bulls and 200 cows during the late 1960s and early 1970s. Hunting seasons were long, with both fall and winter hunts. As moose numbers began to decline, we reduced harvests by eliminating both the cow season and winter season in 1972 and reducing fall bull seasons to 20 days in 1975. Harvests in the late 1970s averaged 775 bulls per year, but bull:cow ratios in the population were low. In 1980 the bag limit was changed from any bull to bulls with an antler spread of at least 36 inches or 3 brow tines on at least 1 antler. Under this management regime, the 1980 bull harvest dropped to 557, down 34% from the 1979 harvest of 848. From 1981 through 1988 the harvest increased, peaking in 1988 with a harvest of 1259 moose. Starting in 1990, however, seasons were reduced in length in response to population declines attributed to severe winters. Moose seasons were again liberalized in 1993 with harvests again increasing and remaining high until the late 1990s.

MANAGEMENT DIRECTION

POPULATION OBJECTIVE

Increase the unit moose population to between 20,000–25,000 moose with a minimum of 25–30 calves:100 cows in the fall.

HUMAN USE OBJECTIVE

Increase the yearly moose harvest of bulls and cows to a combined total between 1200 and 2000 animals.

METHODS

We conducted aerial surveys during fall to learn sex and age composition and population trends in large count areas distributed throughout the unit. Censuses have been conducted periodically in different portions of the unit to obtain population estimates. Surveys were flown during calving season to determine percent twins at birth, and in late winter to determine over winter survival. Computer modeling of the moose population was completed to predict trends. We monitored harvests by requiring permit and harvest ticket reports from all hunters and monitored habitat conditions periodically by examining browse utilization transects in different parts of the unit. Attempts at habitat improvement include updating the Copper River Fire Management Plan. In this plan large portions of the unit are included in a limited fire suppression category in which wildfires are allowed to burn. Work was completed on a controlled burn plan and plant composition data in the proposed burn area were collected. In addition, staff evaluated and responded to land-use proposals that could affect moose habitat.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Long-term population trends for moose are monitored by observing changes in the number of moose counted per hour of survey time during fall sex and age trend counts on established trend count areas. This population index is thought to be a reliable indicator of long-term trends in moose numbers because it is not influenced as much by moose movements and survey conditions as the total number of moose counted. Moose per hour data for the current reporting period include 38 moose per hour in 2000 and 35 in 2001 (Table 1). The rate of moose counted per hour in Unit 13 declined 24% from 1988 to 1994 going from 72 to 55. This decline was attributed to a series of severe winters in the early 1990s. Since 1994, the decline in number of moose counted per hour has accelerated, with 36% fewer moose counted between 1994 and 2001. Since the population high in 1988, the moose per hour count has declined 51%.

Moose censuses were conducted in the moose study area in 13A west during 1994 and 1998 through 2001. Moose density in 1994 was 2.16 moose and 1.5 cows/mi² (Testa personal communication). In 1998 and 1999 the results were almost identical, with average densities of 1.4 moose and 1.1 cows/mi². These data indicate a 31% decline in total moose and a 27% decline in cows between 1994 and 1999. The population in 13A west continued to decline in 2000 and 2001. There were .89 moose and .70 cows per square mile in the census area in 2001. The cow population has declined by 54% since 1994 in this area. Survey conditions were good in all years and the results are thought to represent an actual decline in moose and not census variation.

We used the predator prey model developed by Mark McNay (ADF&G, PredPrey v. 1.0) to model moose, wolf and bear populations in the 13A study area west of Lake Louise. Modeling focused on this area because we have the most complete demographic data for moose, wolves and bears in this study area. We modeled forward from 1994 to the present and 10 years into the future. The model results closely fit observed historic trends for both moose and wolf numbers in 13A. Moose abundance declined at approximately 5% annually through 1999. Future trends predicted by the model include a continued steep decline in the moose population and an eventual decline in wolf densities once moose numbers drop to a very low level.

Population Size

A unitwide population estimate for moose is not available. Density estimates from fall trend count areas range from a low of 0.6 moose/mi² in 13D to a high of 1.2 moose/mi² in 13C (Table 2). An average of 1.0 moose per mi² was observed within the trend count areas during 2001, down 9% from the 1.1 moose/mi² estimate in 1999. Current density estimates are down 50% unitwide from the 1987 and 1988 highs of 2.0 moose/mi². The average density found on count areas cannot be extrapolated unitwide to a population estimate, because count areas are located in fall concentration areas, and densities are not representative of the whole unit.

Population Composition

Population composition data collected during fall sex and age composition counts from 1996 through 2001 are presented in Table 1. The bull:cow ratio in Unit 13 increased slightly from 18 bulls:100 cows between 1996 and 1998 to 21 bull:100 cows in 1999, and has been stable since then. Of all the trend count areas, the bull:cow ratios are lowest in 13A and E (Table 2). An analysis of the bull:cow ratio by age class indicates that there were only 3–6 yearling bulls:100 cows observed during this reporting period (Table 1). Recruitment of yearling bulls is down about 66% from the 12 yearling bulls:100 cows observed in 1988. Fall composition data in recent years indicates less than 10% of the Unit 13 posthunt bull population left to breed were mature bulls. This is especially important because in portions of Unit 13 where bull:cow ratios are the lowest, the few remaining bulls are also the youngest.

Fall calf:cow ratios in 2000 and 2001 were 12 calves:100 cows and 15 calves:100 cows respectively, two of the lowest calf:cow ratios ever observed in GMU 13 (Table 1). Between 1978 and 1988 calf production and survival were high, varying from 22 to 31 calves:100 cows each fall. The 26 calves:100 cows observed in 1996 was the only time during this reporting period that the calf:cow ratio approached ratios observed in the mid 1980s, when moose numbers were increasing in Unit 13.

The number of cows counted per hour of survey time during fall sex and age counts is also monitored. Trends in adult cow abundance are more sensitive to population changes because they are not currently hunted and are more resistant to climatic factors. Between 1986 and 1988 the fall sex and age composition data showed an average cow per hour figure of 47. The 1990–97 average estimate of cows per hour was 39, down by 17%. The cow per hour rate continued to decline in 2000 and 2001 to 29 and 26 cows per hour respectively, about a 42% overall decrease since the population high in 1988. In addition to a decline in cow numbers, the average age of the remaining cows is getting older because of lower calf recruitment

during most of the 1990s. As the population ages, cows become more susceptible to severe winters and predation, thus mortality increases.

Productivity

In 13A West, radiocollared moose subjected to ultrasound pregnancy exams during November of 1994, 1995, and 1997 exhibited an average pregnancy rate of 88%, which was maintained until spring in all but 1 year (Testa 1997). These pregnancy rates approach those observed during the 1980s when calf recruitment to fall was higher. Fall in utero twinning rate was 27% for radiocollared cows in 13A tested by ultrasound. Twinning rate at birth, based on calf observations, has averaged 16% since 1994. Twinning for collared cows in 13A during the last few years increased to about 18%. Twinning rates are obtained in other units by aerial surveys in early June, just past the peak of parturition. Twinning rates show large annual fluctuations that probably reflect small sample size more than reproductive change. More extensive surveys were flown during spring 2001 and 2002 in 13 B, C and E. The twinning rate was 15% in 2001 and 31% in 2002. For interior Alaska moose populations, twinning rates of 20% indicate average productivity.

Distribution and Movements

Data from fall composition surveys, censuses, and stratification flights indicate in recent years moose densities were highest in Units 13A, 13B, and 13C (Table 2). Moose were most abundant along the southern slopes of the Alaska Range in 13B and 13C and the eastern Talkeetna Mountains in 13A. Unit 13D and the Lake Louise Flats have the lowest observed density. Fall rutting and postrutting concentrations are in subalpine habitats. The distribution of wintering moose depends on snow depth. Moose move down to wintering areas at lower elevations as snow depth increases. Known winter concentration areas include the upper Susitna River, the eastern foothills of the Talkeetna Mountains, the Tulsona Creek burn, and the Copper River floodplain in Unit 13C.

Mortality

Harvest

Season and Bag Limit. Season dates were 20 August–20 September for the general state moose hunt between 1993–98 and then became 1 September–20 September since 1999. Until 2001 the bag limit was 1 bull with a spike/fork antler on 1 side or 3 brow tines on 1 side, or a spread of 50 inches or more. In 2001 the tine regulation changed from a minimum of 3 to a minimum of 4 brow tines. A Tier II subsistence permit hunt was established in 1995 with 150 Tier II permits issued. Permits are limited to 1 per household. The Tier II hunting season during this report period was 15–31 August. A federal subsistence hunt was established in 1990 for residents of Units 13, 12 and 20 with only 1 permit issued per household, a bag limit of any bull and season dates of 1 August–20 September.

Board of Game Actions and Emergency Orders. In 1993 the Board of Game standardized moose seasons and bag limits along the road system in Southcentral Alaska. Because of intensive management legislation in 1996 required for moose and caribou, the board changed the moose management objectives for Unit 13. The moose population objective was established as 20,000 to 25,000 moose. Composition objectives adopted include a calf:cow

ratio of 30 calves:100 cows and a yearling bull ratio of 10:100 during fall composition counts. The human-use objective established for the Unit 13 moose hunt was to provide a human harvest of 1200 to 2000 moose per year. This range was adopted due to board findings that human consumption of moose is the preferred use of moose in Unit 13. The amount necessary to meet the subsistence need was established at 600 moose each year. In 1999 the Board reduced the moose season by 10 days in Unit 13 with season dates of 1–20 September. In 1997 the board increased the Tier II season by 4 days, with season dates of 1–19 August, then in 1999 changed the season dates to 15–31 August. The 2000–01 moose season was reduced by emergency order in May 2000 for units 13A, B, and E, with season dates of 1–15 September, while 13C and D remained unchanged. During the spring 2001 meeting, the Board changed the bag limit from a minimum of 3 brow tines to 4 for the 2001 season and eliminated nonresident moose hunting in GMU 13 starting in 2002. The season remained 1–20 September.

Hunter Harvest. In 2000–01, reported harvest for Unit 13 was 562 moose from the combined state and federal seasons (Table 3). The highest harvest during this reporting period was 1027 moose taken in 1996. Since then the harvest has declined 45%. Since 1995, when hunting pressure peaked at 6215 in GMU 13, hunting effort has declined 33%. During 2000, 4137 hunters reported hunting in Unit 13.

General Hunt. Harvest ticket returns from 2000 showed 477 bulls taken by 3510 hunters during the general state hunt (Table 4). Unit harvest for all hunters reporting harvest locations in this hunt during 2000 includes: 13A – 106; 13B – 112; 13C – 100; 13D – 62; 13E – 85. Harvests in all units except 13D declined dramatically.

Permit Hunts. The current federal subsistence hunt replaced a previous state registration subsistence hunt in 1990. The Bureau of Land Management (BLM) assumed management of subsistence moose hunting on federal land in 1990, following the McDowell decision. They issue registration permits to applicants who are rural residents of Unit 13 (RM 313), as well as residents of those communities in adjacent units (RM 314) that convinced the Federal Board that they needed to hunt in Unit 13. Only 2 small tracks of federal land in 13B and 13D are open to this hunt. Harvests under this permit hunt are presented in Table 5. This is a very popular hunt for Unit 13 residents, shown by the high number of households getting permits. Harvests are low and have been relatively stable the last 5 years with no trend evident. Because the amount of federal land open for this hunt is extremely limited, the any-bull bag limit has resulted in a low bull:cow ratio on federal lands surveyed; but because harvests are so concentrated, this hunt does not influence bull:cow ratios on state lands.

A state subsistence moose hunt (TM300) with 150 permits issued for any bull was initiated in 1995, with permits allocated under the Tier II permitting system. The harvest in 2000 was 40 bulls (Table 5). Since inception, the harvest is up 54% and the hunter success rate increased from 22% to 32%. This hunt is becoming more important to permit holders as moose numbers decline. This subsistence harvest has gone from 3% in 1995 to 7% of the total unit harvest, but is still so low it has little influence on age composition of bulls remaining after the hunting season. Antler composition data from this harvest show a smaller average size of harvested bulls than those taken under the general hunt.

Illegal Harvests. Unreported and illegal harvest estimates are presented in Table 3. The estimate for the illegal take is high, (and I believe could exceed 10% of the reported harvest) because of the spike-fork/50-inch regulation. A number of yearlings taken and reported as forks may actually be illegal because of the difficulty distinguishing small paddles and palms from forks. Also, I believe numerous sub-50-inch bulls are harvested because few hunters can reliably tell a 50-inch bull from a 45-inch bull in the field. This assumption is based on 7 years of field experience monitoring this hunt as well as F&W Protection case reports. Many of the illegal bulls taken are initially misidentified as legal by the hunter, and then, once an illegal bull is taken, I believe most are subsequently reported as legal. This increased illegal harvest is important because it often comes from heavily hunted areas where very few legal bulls remain. Fall sex composition data support the assumption that the illegal take is high because current bull:cow ratios in some areas, such as 13A, are lower than expected given the number of bulls that should be protected under a spike-fork/50-inch regulation.

Hunter Residency and Success. Local residents of Unit 13 accounted for between 8% to 10% of the moose harvested under the general season, according to harvest ticket returns (Table 4). Nonresident moose hunters averaged 10% of the unit-wide moose harvest during this reporting period. Alaskans residing outside Unit 13 accounted for the remaining 80% of the harvest. Last year, under the Tier II permit hunt, unit residents harvested 85% of the moose.

The success rate for moose hunters in the Unit 13 general hunt was 14% in 2000, down from the 16% to 17% observed between 1996 and 1999 (Table 4). Hunter success for the 10-year period before 1993 averaged 24%. The hunter success rate in 2000 for the Tier II subsistence permit hunt was 32% and 9% for the federal subsistence hunt (Table 5). Successful moose hunters in the general hunt reported spending an average of 7.3 days hunting in 2000, down slightly from the 7.8 days average for the rest of the reporting period. In 1989 harvest ticket returns show that 3,556 hunters reported an average of 5.9 days hunting for a total of 21,240 days hunting moose in Unit 13. Hunting effort peaked in 1995 when 5483 hunters spent an average of 10.2 days hunting, for a total of 55,938 days afield. Hunting effort declined in 2001 to approximately 26,230 man-days.

Harvest Chronology. Chronology data for the general hunt are presented in Table 6. The last 2 weeks of the season have accounted for more than half the harvest in every year since 1994. This harvest pattern is predictable because moose are more vulnerable later in September. Leaf fall starts occurring at this time and onset of the rut initiates calling and increased bull movements.

Transport Methods. During the last 5 years, 4-wheelers have been the most important method of transportation (Table 7). It is obvious that Unit 13 is an important 4-wheeler and off-road vehicle area for moose hunters. In the last 2 years, hunters using either 4-wheelers or ORVs are the largest group of hunters and have averaged approximately 60% of the total moose harvest. As a group, aircraft and ORV users other than 4-wheelers have the highest rate of success, while those using a 4-wheeler have a lower success rate.

Other Mortality

Brown bears are abundant in Unit 13 and are important predators of neonatal moose calves, taking up to 50% of the calves born within the first 6 weeks of life (Ballard et al. 1981).

Although brown bears kill adult moose, the rate is much lower than calves. Because bears kill so many calves, a reduction in bear predation can result in increased calf survival that is carried over as spring recruitment (Ballard et al. 1987). Wolf numbers in Unit 13 started increasing in 1990. The fall 1998 and 1999 estimates exceed 500 wolves (11.7 wolves/1000km²), the highest in over 25 years. In the 13A west study area, the fall 1999 moose/wolf ratio was 32:1. This ratio is so low that wolf predation alone could result in a decline in the moose population, especially because in Unit 13 wolves continue to take moose even when caribou are present (Ballard et al. 1987). Wolf numbers declined slightly in 2000, with a preliminary fall estimate of approximately 400 wolves.

The winter severity index between 1996 and 1999 shows a period with mild to average snow depths. The unitwide winter severity index is based on snow depths from 17 snow courses throughout the unit. Moose numbers continued to decline during this period despite the favorable weather conditions. The winter of 2000 was severe and is the second worst winter recorded. Spring 2000 surveys suggest increased mortality resulted from deep snow conditions, especially in 13E, which had record snow depths. The winter of 2001 was considered an average winter. Observations of winter mortality in Unit 13 over the years have led to the conclusion that moose mortality due to deep snow conditions has not been density dependent. Instead, there appears to be a threshold effect triggering increased calf mortality once snowfall reaches about 30 inches in depth. As the snow pack increases, yearlings, then adult bulls, and finally adult cows die, regardless of moose densities. In addition to killing moose, deep snows often make it easier for wolves to take moose, which increases predation mortality.

HABITAT

Assessment

Unit 13 has numerous areas where habitat improvement could produce more favorable browse conditions for moose. Because of the size and remoteness of much of the unit, wildfire is considered the only feasible tool for extensive habitat improvement. Wildfires occurred throughout much of Unit 13 before 1950, when fire suppression activities were initiated. Since then, negligible acreage has burned. Current fire suppression policies are presented in the Copper River Fire Management Plan, which sets aside large portions of the unit as let-burn areas where wildfires will not be suppressed. However, this plan has often been ignored and some wildfires have been suppressed, even if they occurred in an area designated as limited suppression. The current level of fire suppression has resulted in fewer fires and reduced seral habitat available as moose browse. The effect has been to lower the moose carrying capacity over extensive portions of Unit 13. Because of the lack of fire-created seral plant communities, climax upland and riparian willow communities are the most important habitat types for moose in the unit.

Evaluation of browse in important moose areas from 1983 to 1986 indicates browse species were able to withstand the level of use occurring at that time. Research continues on evaluating available browse and use by moose in 13A as part of an ongoing moose research project. Preliminary indications are that current browse utilization rates are sustainable (Collins 1997).

The use of prescribed fires to replace wildfires as a method of improving moose habitat has not been successful in Unit 13. The climate in Unit 13 typically limits the use of prescribed fire to only the driest years, when the danger of an escaped fire increases. Also, scattered cabins and private land ownership in the Basin increase the liability associated with the use of prescribed fire. In spite of problems associated with controlled burns, work with BLM and DNR is ongoing and a prescribed fire is scheduled for the summer of 2002 should the fire prescription be met. The area selected for the burn is the prior controlled burn site around Kelly Lake on the south slopes of the Alphabet Hills in Unit 13B. This area was actually lit in 1984, but the fire did not carry because it was too late in the season and ground moisture was too high.

Habitat improvement by mechanical methods such as crushing is an alternative to burning. To be effective, mechanical treatment must be done on riparian habitats where moose concentrate during critical winter months. However, mechanical treatment is expensive, and the cost limits mechanical treatment to small but important concentration areas near the road system where access for heavy equipment is available. One such small site was crushed in 1993, and initial regeneration of willows was good. Additional sites for mechanical treatment have been identified along the Copper River in Unit 13C where moose winter during deep snow years. Work continues toward gaining permission from landowners to crush this area.

Low densities of moose and an annual twinning rate of up to 30% indicated habitat is adequate for population growth if the predation pressure could be decreased.

CONCLUSIONS AND RECOMMENDATIONS

Changes in moose-per-hour rates during fall moose counts indicate that unitwide moose abundance declined between 1994 and 2001. Census data from 1994, and 1998–2001 indicate a 50% decline has occurred in Unit 13A. Declines occurred in all sex and age classes.

The calf:cow ratios during fall sex and age composition counts over the last few years are the lowest ever observed in Unit 13. The low ratios are attributed to poor survival and are 25 to 30% below levels observed between 1978 and 1988. Initial calf production has changed little over 20 years, based on pregnancy and birth rates. Pregnancy rates during fall and early spring, coupled with birth rates for pregnancy-checked radiocollared cows, approach those observed in Unit 13 moose during periods of moose population growth. Twinning rates fluctuate between units and years, probably due mostly to small sample size, and are average for an interior moose population on mature range.

The decline in the number of cows observed during both fall trend counts and censuses continued during the relatively mild winters that occurred during this reporting period. Modeling of the moose population leads to the conclusion that cow abundance will continue to decline over the next few years. The rate of decline could accelerate due to an aging cow population. The decline in calf recruitment has led to a population with an older age structure. The risk of a major decline in cows during a severe winter increases every year because older moose are more susceptible to severe winters and the associated increased predation.

Increased human harvests under the spike-fork/50-inch 3 brow tine regulation, predation, and a decline in recruitment reduced the bull:cow ratios from levels observed in the late 1980s. In some portions of the unit, the bull:cow ratio was as low as ever observed historically. Harvests under the spike-fork/50-inch 3 brow tine regulation greatly skewed the age structure of the Unit 13 bull population so that almost 80% of the bulls left to breed were estimated to be only 3 years of age or younger. Fall pregnancy rates in 13A indicate this low bull:cow ratio has not, as of yet, reduced productivity. However, long-term effects of breeding accomplished by very young bulls are unknown. It certainly has disrupted the normal rut pattern of Alaskan moose in which large, mature bulls exhibit rutting behavior that ensures an effective and efficient breeding season. Any harvest strategy that maintains most of the breeding bull population in the young cohorts should not be considered a suitable long-term management option.

Changing the bag limit to SF/50 and 4 brow tines, along with reducing the length of the season has resulted in a slight increase in the bull:cow ratio. It is too early to tell how this will impact the age structure of the bull population. Hopefully some older bulls will be left in the population to allow for a more structured and efficient rut.

Additional protection for the bull population is needed during periods of low calf survival. Although the bull:cow ratio increased, it is only because bulls declined at a slower rate than cows. More bull recruitment is needed. To accomplish this, I recommend that the bag limit be changed to eliminate the forked yearling as a legal bull. Maintaining a spike-yearling in the bag limit will allow some harvest of young bulls. This harvest would be even more focused on the slower growing spike yearlings, thus cropping poorer individuals from the gene pool in an attempt to address some concerns about the genetic effects of the selective harvest strategy. Also, enforcement problems would be greatly reduced because many of the illegal bulls taken are yearlings with paddles and palms that were mistaken for forked antlers.

Hunters have concentrated in Unit 13 because it has more open habitat than other units, which are predominantly forested. ORV access is easier in non-forested areas and there are extensive ORV trail systems in Unit 13. But even more important is the effect of the spike-fork/50-inch regulation on concentrating hunters in the open habitats of Unit 13. When you combine increased visibility of moose with the opportunity to use a 4-wheeler, hunting effort increases. Because moose can be more visible in open habitats, a hunter has more opportunity to observe the antlers and determine if the bull is legal. The impact of the 50-inch regulation has been to discourage hunting in timbered areas because it is more difficult to get an unobstructed view of the antler to determine if a bull is legal. It is now necessary to redirect hunting pressure to units that have higher bull:cow ratios. Because hunting is more difficult in these areas, it will be necessary to adopt regulations that force hunters out of Unit 13 and into other areas. Requiring a drawing permit to hunt in Unit 13 would certainly accomplish this. Requiring a unit-specific harvest may accomplish this as well. Under the unit-specific system, a hunter would choose which roadside unit he wants to hunt moose in that year. Once that choice was made, that would be the only unit the hunter could hunt in that year.

I also recommend adopting other management actions that would improve survival rates of moose calves that can then be recruited into the population. This action would reverse the downward population trend observed in the unit 13 moose population. Modeling efforts

suggest that manipulation of both brown bear and wolf populations would have a significant positive effect on moose abundance. A 3% annual decrease in the brown bear population and a reduction of the wolf population to a density of 3–5 wolves/1000km² during the spring should result in a positive 2–5% annual growth rate of the moose population.

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Table 1 Unit 13 fall aerial moose composition counts and estimated population size, 1996–2001

Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves %	Adults	Total moose observed	Moose /hour	Density moose mi ² (range)
1996/97	18	6	25	17	4972	6015	50	1.2 (0.2–3.0)
1997/98	18	6	19	14	5359	6209	56	1.4 (0.2–3.3)
1998/99	18	4	14	11	4904	5496	46	1.2 (0.5–2.1)
1999/00	21	4	14	11	4234	4738	46	1.1 (0.2–1.8)
2000/01	20	3	12	9	4000	4382	38	1.0 (0.8–4.4)
2001/02	21	3	15	11	3949	4446	35	1.0 (0.6–4.5)

Table 2 Unit 13 fall aerial moose composition counts, 2001

Unit	Bulls: 100 Cows	Yearling Bulls:100 Cows	Calves: 100 Cows	Calves %	Total Moose Observed	Moose /hour	Density moose mi ² (range)
13A	18	3	15	11	845	36	0.9
13B	22	3	16	11	1833	40	0.9
13C	22	4	12	9	276	32	1.2
13D	78	6	14	7	196	25	0.6
13E	17	4	16	12	1092	29	0.9

Table 3 Unit 13 moose harvest^a and accidental death, 1996–2000

Regulatory year	Reported				Estimated			Accidental			Grand Total
	M	F	U	Total ^b	Unreported	Illegal	Total	Road	Train ^c	Total	
1996/97	1018	1	0	1027	25	25	50	50	15	65	1142
1997/98	930	1	10	937	25	25	50	50	15	65	1052
1998/99	913	5	50	939	25	25	50	50	14	64	1053
1999/00	813	1	9	823	25	25	50	50	15	65	938
2000/01	550	3	9	562	25	25	50	50	76	126	738

^a Includes permit hunt harvest, harvest tickets and federal subsistence hunts.

^b Includes unknown sex.

^c 13E – the Alaska Railroad.

Table 4 Unit 13 moose hunter residency and success for general harvest ticket hunt only, 1996–2001

Regulatory Year	Successful				Unsuccessful				Total Hunters
	Local ^a Resident	Nonlocal Resident	Non- resident	Total ^b	Local ^a Resident	Nonlocal Resident	Non- resident	Total ^b	
1996/97	85	765	84	951	402	4099	122	4676	5627
1997/98	66	709	88	869	395	4095	109	4641	5510
1998/99	66	697	91	860	410	3523	124	4083	4943
1999/00	70	566	86	722	378	3192	151	3721	4443
2000/01	38	392	47	477	353	2533	116	3033	3510

^a Residents of Unit 13

^b Includes unspecified residency

Table 5 Unit 13 moose harvest data by hunt, 1996–2000

Hunt Nr	Regulatory year	Permits issued	Percent Did not Hunt	Percent Unsuccessful Hunters	Percent Successful Hunters	Bulls	Cows	Unknown	Harvest
Tier II	1996/97	150	13	75	25	32	1	0	33
TM300	1997/98	150	19	77	23	25	0	0	25
	1998/99	150	17	71	29	37	0	1	38
	1999/00	150	17	70	30	35	0	--	35
	2000/01	150	10	68	32	40	0	--	40
BLM Subsistence									
RM313	1996/97	500	26	88	12	43	0	0	43
RM314	1997/98	488	26	86	14	43	0	0	43
	1998/99	557	29	89	11	41	0	0	41
	1999/00	691	29	86	14	67	0	0	67
	2000/01	740	32	91	9	43	0	2	45

Table 6 Unit 13 moose harvest chronology percent by week for general harvest ticket hunt, 1996–2000

Year	Season dates	Week of Season					<i>n</i>
		1 st	2 nd	3 rd	4 th	5 th	
1996	20 Aug.–20 Sept.	10	9	21	35	25	910
1997	20 Aug.–20 Sept.	15	11	17	31	26	837
1998	20 Aug.–20 Sept.	13	11	21	30	24	834
1999	1 Sept.–20 Sept.	7	33	33	28		696
2000	1 Sept.–20 Sept.	16	38	46			435

Table 7 Unit 13 moose harvest percent by transport method for general harvest ticket hunt, 1996–2001

Regulatory Year	Percent of Harvest								<i>n</i>	
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway Vehicle	Airboat		Unknown
1996/97	12	3	7	36	0	23	17	0	1	951
1997/98	10	3	9	41	0	19	15	1	2	869
1998/99	10	4	7	40	0	20	17	1	1	860
1999/00	12	3	10	47	0	23	16	0	2	628
2000/01	11	4	6	42	0	19	16	0	1	471

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 14A (2561 mi²)

GEOGRAPHIC DESCRIPTION: Matanuska Valley

BACKGROUND

Moose were scarce in the Matanuska Valley as “colonists” arrived and settled during the 1930s but probably grew to numbers approaching 7000 during the 1960s (Griese 1996). Moose numbers fluctuated with deep snow winters but stabilized between 5000 and 6000 animals in the 1990s.

In the 40 years following statehood (1960–2000), hunters reported a harvest of more than 23,629 moose in Unit 14A. Annual harvest levels in the first 12 years (1960–71) ranged from 200–1300 (Griese 2000). The harvest was predominantly bulls, averaging 350 annually, but the harvest of antlerless moose was as high as 1131 in 1962–63 (Griese 2000). Antlerless moose seasons were discontinued from 1972–77 and the mean annual harvest of bulls declined to 251 (range:167–346). Antlerless seasons began again in 1978 and from 1978–98 the annual cow harvest ranged from 0 (1990) to 284 (1996). Annual harvest during the “any bull” period of 1979–1992 averaged 367 (range:201–530) (Griese 2000). From 1993–2000, the period with antler restrictive bag limits, the average harvest dropped slightly to 342 (range:233–554).

Starting in 1993, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least 1 side or a minimum of 3 brow tines on at least 1 side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork-50-inch” (SF50) (Schwartz et al 1992).

The human population in the Matanuska/Susitna Valley continues to be one of the fastest growing areas in the state. Land clearing activities associated with settlements and road construction promotes the growth of preferred moose browse and a concomitant growth in moose/human conflicts. During the 1990s, motorists killed an average of 180 moose annually in the Matanuska/Susitna Valley.

Habitat enhancement efforts during the 1990s were aided by wildfires. In 1993 a successful cooperative effort between state agencies resulted in a 900-acre controlled burn to enhance wintering moose habitat near Willow (Collins 1996). In June 1996, a 37,000-acre fire occurred

in the Big Lake area (Griese and Masteller 1998). Even though the habitat enhancement from the Big Lake burn will greatly aid moose in the future, it politically restricted future prescribed burns. The Ruffed Grouse Society and the Department of Fish & Game have begun a habitat enhancement project in the Matanuska Valley Moose Range. Every year, 100–150 acres of aspen forest will be cut to produce early successional growth that will have a positive impact on moose and other wildlife species.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- To produce high yields of moose for humans and to provide maximum opportunity to participate in hunting for moose
- To provide opportunities for nonconsumptive uses.

POPULATION OBJECTIVES

To maintain a posthunt population of 6000–6500 moose with a sex ratio of 20–25 bulls:100 cows.

HUMAN-USE OBJECTIVE

To achieve an annual hunter harvest of 360–750 moose.

METHODS

We conducted Becker surveys on December 1–4, 2000 and October 23–27, 2001 (Becker and Reed 1990). We generated a population estimate and age/sex statistics using MOOSEPOP (Becker and Reed 1990). During both surveys we attempted to categorize antler size of bulls and identify brow-tine counts on bulls with 30-inch or greater antlers.

We aerially sampled a portion of the primary wintering habitat in the subunit during early March 2000 and 2001 to quantify the percent of short yearlings in the population as an assessment of recruitment.

We determined hunter effort and harvest composition from the general season and permit hunt reports. The Alaska Railroad Corporation provided numbers of moose killed by trains, and the Department of Public Safety provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property. Age categories (calf, yearling, adult) and sex of moose from road and railroad mortalities were provided by charities receiving the meat. We required the charities to surrender moose incisors for aging.

From a fixed-wing aircraft, we radiotracked and located moose radio collared in March 1996 and February 1997 (Griese and Masteller 1998). Moose were located 10 times between July 1997 and February 2000, delineating distribution during mid-winter, calving, midsummer, hunting, rutting and post-rutting seasons. Wildlife Forever, a hunter sponsored organization, provided

\$4000 to begin this project, and Safari Club International provided an additional \$2500. Results of the project are presented in the Appendix.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The population increased about 15% between the fall survey in 2000 (5552 ± 571 : 80% C.I.) and the fall survey in 2001 (6679 ± 453 : 80% C.I.) (Table 1).

Population Composition

We observed 18 and 19 bulls:100 cows in the fall of 2000 and 2001, respectively (Table 1). Both were below objective levels (20–25 bulls:100 cows). Calves displayed high overwinter survival during the report period (Table 2).

Distribution and Movements

See Appendix.

MORTALITY

Harvest

Season and Bag Limit. In 2000, the resident and nonresident season included an archery-only season from 10–17 August, a general season from 20 August–25 September, and a general ‘spike-fork-only’ season from 5–15 December. During the archery-only and early fall general season, the bag limit was 1 bull with SF-50 antlers restrictions.

In 2001, the general season was extended to 30 September. The department issued 50 permits for antlerless moose for the 20 August–25 September period

Board of Game Actions and Emergency Orders. During the spring 2001 Board of Game meeting the winter ‘spike-fork-only’ hunt was eliminated and the department informed the Board our intent to issue 50 antlerless moose drawing permits because the population exceeded the upper end of the previous population objective of 5500. The Board increased the population objective (from 5000–5500 to 6000–6500) and extended the harvest objective (from 600–700 to 360–750). This action came at the request of local advisory committees. The department also adjusted the potential allotment of antlerless permits from 600 down to 400.

Hunter Harvest. The bull moose harvest in 2000 and 2001 was comparable to 1998 and 1999 but down from 1996 and 1997 (Table 3). While antler sizes of moose harvested during the general season suggest similar composition to previous years, there is a lack of cooperation by hunters. Hunters failed to provide antler measurements on over 35% of the harvest reports. It is unclear if this statistic reflects a substantial increase in the harvest of sublegal bulls.

Permit Hunts. The department issued 50 antlerless moose drawing permits for the northern Matanuska River area in 2001 resulting a harvest of 30 cows (Table 4). Any-bull permits were discontinued in 2000.

Hunter Residency and Success. Hunter success increased slightly in 2001 to 13% (Table 5). Residency composition of hunters changed little from previous years.

Harvest Chronology. The harvest chronology was similar to past years (Table 6). Hunters took advantage of the 5-day season extension in 2001, taking 68 moose in this period (Table 6).

Transport Methods. Transport methods were similar to past years (Table 7). With the removal of the late ‘spike-fork’ season, snowmachines were not used in the 2001 season (Table 7).

Accidental and Illegal Mortality

Accidental human-caused moose mortality during the 5-year period 1997–2001 averaged 172 moose killed by highway vehicles and 17 by train (Table 3). The highway collisions went up in 2001–02 because of the increase in the moose population rather than deep snow conditions.

HABITAT

Enhancement

During the winter of 2001–02, the Ruffed Grouse Society and the Department of Fish & Game conducted the first year of a multi-year project enhancing habitat in the Matanuska Valley Moose Range. One hundred acres of an 80-year-old aspen stand were cut.

CONCLUSIONS AND RECOMMENDATIONS

The new harvest objective (360–750) was met in 2001 (Table 3). The 400 antlerless permits issued for the 2002 season will likely keep the harvest within the objective levels. An antlerless harvest is needed to bring the bull:cow ratio and the population size to objective levels. Many moose died of apparent malnourishment due to late snowfalls in April of 2002 showing what is to be expected if moose exceed the carrying capacity for the unit.

We believe effective intensive management in this subunit requires investigation into the distribution and movement of moose. Specifically, studies investigating the winter movement of moose into the Pt. MacKenzie agricultural project and the 1996 Big Lake burn area will reveal the proportion of the moose that are migratory and where the migratory individuals spend the non-winter months. The Pt. MacKenzie winter population exceeds 10 moose/mi², one of the highest densities in the state. These areas are critical to moose in the unit and may be used by moose summering within the boundaries of Units 16A, 16B, and 14B where moose populations have declined 30–40% in the past few years.

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Table 1 Unit 14A fall aerial moose composition surveys and censuses, 1991–2001

Regulatory Year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves(%)	Adults Observed	Moose Observed	Moose /mi ²	Estimated Population Size
1991–92 ^a	14	5	39	26	1110	1472	3.7	5885±706 ^b
1992–93 ^c	9	6	40	27	697	934	n/a	5200–6200 ^b
1993–94 ^d	16	11	37	24	942	1232	3.6	5672±798 ^b
1994–95 ^c	21	8	35	22	1098	1398	n/a	5500–6500
1995–96 ^e	--	--	--	--	--	--	--	5000–5500
1996–97 ^f	23	6	42	25	1696	2290	n/a	5500–6500
1997–98 ^g	14	5	30	21	611	774	n/a	5000–6000 ^b
1998–99 ^h	17	7	33	22	1191	1509	3.0	4729±530 ^b
1999–00 ^h	19	10	37	24	1021	1317	3.4	5348±721 ^b
2000–01 ^h	18	7	37	19	1300	1693	3.5	5552±571 ^b
2001–02 ^h	19	8	34	22	1781	2301	4.2	6679±453 ^b

^a Gasaway et al (1986) survey

^b 80% confidence interval

^c Sampling of 1991 surveyed units (Griese and Masteller,1996)

^d Becker survey

^e No surveys

^f Combined results of Matanuska River drainage east of Moose Creek and composition surveys in CAs 1–7 &Pt. MacKenzie

^g Incomplete Becker survey due to antler drop

^h Modified Becker survey (non-random sampling but duplication of 1991 sampling units)

Table 2 Unit 14A late winter aerial moose composition surveys, 1990–2001

Regulatory year	Date	Count areas	Total moose	Calves ^a	Percent calves
1990–91	03/04–11	5,6&8	1348	167	12
1991–92	02/25	7	121	26	21
	04/10	3–6 & 8	546	76	14
1992–93	03/24	4–8	693	131	19
1993–94	03/05–09	4–8	981	175	18
1994–95	04/03–04	4–8 & Pt. MacKenzie	518	75	14
1995–96	03/28	6 & Pt. MacKenzie	471	85	18
1996–97	04/08–09	5,6,8 & Pt. MacKenzie	226	53	23
1997–98	no count				
1998–99	03/12–15	4–8 & Pt. MacKenzie	1178	201	17
1999–00	03/08–10	1,2,4–8 & Pt. MacKenzie	1291	222	17
2000–01	03/26–04/02	1–8 & Pt. MacKenzie	633	120	19
2001–02	03/28–29	1,3,5–8 & Pt. MacKenzie	899	148	16

^a Calves = short yearlings

Table 3 Unit 14A moose harvest^a and accidental death, 1990–2001

Regulatory year	Reported			Estimated			Accidental deaths ^e			Grand total
	M	F	Total ^b	Unreported ^c	Illegal ^d	Total	Road	Train	Total	
1990–91	258	0	259	13	35	55	140	22	162	476
1991–92	490	39	534	25	25	50	166	15	181	765
1992–93	530	157	694	27	30	57	132	7	139	890
1993–94	233	204	438	12	40	52	166	18	193	683
1994–95	281	242	532	14	60	74	260	40	300	906
1995–96	335	128	471	22	50	72	85	11	96	639
1996–97	554	284	846	35	50	85	185	17	202	1133
1997–98	488	249	741	33	55	83	168	16	184	1008
1998–99	376	212	596	25	55	80	129	14	143	819
1999–00	319	0	328	23	60	83	181	34	215	626
2000–01	314	1	320	22	60	82	131	7	138	540
2001–02	349	30	379	27	60	87	250	14	264	730

^a Includes permit hunt harvest

^b Includes moose of unknown sex

^c Derived by taking 5–7% of the reported kill from harvest tickets

^d Includes moose taken in defense of life or property

^e Road and train kills are minimum numbers

Table 4 Moose harvest data by permit hunts in Unit 14A, 1990–2001

Hunt	Regulatory year	Applicants	Permits issued	Percent ^a did not hunt	Percent ^a unsuccessful hunters	Percent ^a successful hunters	Bulls	Cows	Total
DM411 (Any bull–early fall)									
	1995–96	1521	70	16	54	29	20	0	20
	1996–97	1978	100	10	53	37	37	0	37
	1997–98	1414	50	6	70	24	12	0	12
	1998–99	1463	50	16	52	28	14	0	14
	1999–00 ^b	--	0	--	--	--	--	--	--
DM412 (Any bull – late fall)									
	1995–96	1078	20	5	35	60	12	0	12
	1996–97	1235	30	4	11	86	24	0	24
	1997–98	1162	20	20	25	55	11	0	11
	1998–99	1200	20	10	45	45	9	0	9
	1999–00 ^b	--	0	--	--	--	--	--	--
DM418 (Antlerless - late fall)									
	1993–94	3760	70	13	40	47	3	30	33
	1994–95	5464	100	10	13	77	5	71	76
	1995–96	4781	70	14	31	54	2	36	38
	1996–97	3866	70	14	0	86	2	58	60
	1997–98	3252	70	4	20	76	0	53	53
	1998–99	3740	70	11	49	40	2	26	28
	1999–00 ^b	---	0	---	---	---	---	---	---

Table 4 Continued

Hunt	Regulatory year	Applicants	Permits issued	Percent ^a did not hunt	Percent ^a unsuccessful hunters	Percent ^a successful hunters	Bulls	Cows	Total
DM419 & 420 (Antlerless-early fall)									
	1990-91	0	0	---	---	---	---	---	---
	1991-92	7057	100	13	48	39	0	39	39
	1992-93	11,000	400	12	49	39	3	154	157
	1993-94	10,390	400	10	44	46	4	174	179
	1994-95	11,185	400	10	46	44	4	169	174
	1995-96	10,075	200	7	48	46	1	90	91
	1996-97	10,447	500	8	44	48	3	225	231
	1997-98	8675	450	8	48	44	1	195	197
	1998-99	9230	400	8	46	46	1	182	183
	1999-00 ^b	---	0	---	---	---	---	---	---
DM409 (Antlerless-N. Matanuska River Area)									
	2001-02	4803	50	8	32	60	0	30	30

^a Percent of permits issue^b Discontinued hunt

Table 5 Unit 14A moose hunter residency and success ^a, 1990–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^b resident	Nonlocal resident	Nonres.	Unk.	Total (%)	Local ^b resident	Nonlocal resident	Nonres.	Unk.	Total (%)	
1990–91	242	3	8	6	259 (14)	1466	22	14	26	1528 (86)	1787
1991–92	469	11	9	6	495 (17)	2286	39	12	23	2360 (83)	2855
1992–93	500	12	12	15	539 (16)	2629	50	24	102	2805 (84)	3344
1993–94	215	4	1	6	226 (9)	2291	59	11	68	2429 (91)	2655
1994–95	274	6	1	1	282 (11)	2208	46	4	18	2286 (89)	2568
1995–96	294	11	2	3	310 (9)	2997	84	22	17	3120 (91)	3430
1996–97	471	11	11	1	494 (12)	3324	79	40	21	3464 (88)	3958
1997–98	435	21	5	7	468 (12)	3161	68	43	18	3299 (88)	3758
1998–99	332	16	11	3	362 (11)	2837	85	30	27	2979 (89)	3341
1999–00	311	9	5	0	325 (11)	2429	64	21	29	2543 (89)	2871
2000–01	297	13	7	3	320 (11)	2427	47	38	16	2528 (89)	2848
2001–02	323	13	11	2	349 (13)	2256	45	30	11	2342 (87)	2691

^a Does not include drawing permit hunters^b Unit 14 residents

Table 6 Unit 14A moose harvest chronology^a 1990–2001

Regulatory year	August			September					November	December			Total
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15	Unknown	
1990–91 ^b	--	--	--	211	36	--	--	--	--	--	--	12	259
1991–92 ^c	--	--	--	260	109	110	--	--	--	--	--	20	499
1992–93 ^c	--	--	--	260	120	144	--	--	--	--	--	15	539
1993–94 ^d	--	76	17	24	37	68	--	--	--	--	--	6	227
1994–95 ^d	--	63	31	50	44	87	--	--	--	--	--	16	279
1995–96 ^e	3	69	20	47	31	45	--	--	41	8	36	20	310
1996–97 ^e	8	88	20	43	50	66	--	--	133	30	39	17	494
1997–98 ^e	3	85	22	35	41	61	--	--	110	41	51	19	468
1998–99 ^e	2	71	25	43	39	57	--	--	46	21	45	13	362
1999–00 ^f	6	57	14	32	25	43	52	--	--	35	50	14	328
2000–01 ^f	4	68	20	38	30	43	24	--	--	27	55	11	320
2001–02 ^g	8	61	28	35	42	46	46	68	--	--	--	15	349

^a Does not include drawing permit hunts^b Open season = Sep 1–10^c Open season = Sep 1–20^d Open season = Aug 20–Sep 20 (SF/50 –“spike-fork/50-inch”)^e Open season = Aug 10–17 (Archery only), Aug 20–Sep 20 (Gen.SF/50), Nov 20–Dec 15 (SF)^f Open season = Aug 10–17 (Archery only), Aug 20–Sep 25 (Gen.SF/50), Dec 5–Dec 15 (SF)^g Open season = Aug 10–17 (Archery-only), Aug 20–Sep 30 (Gen.SF/50)

Table 7 Unit 14A percent transport methods of successful moose hunters^a, 1990–2001

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Sample size
1990–91	7	7	12	22	0	10	35	7	259
1991–92	4	4	12	24	0	12	38	6	499
1992–93	4	5	13	22	0	7	42	5	539
1993–94	4	5	12	23	0	7	43	6	228
1994–95	4	3	13	26	0	7	40	7	292
1995–96	2	3	10	29	1	2	41	7	310
1996–97	2	3	7	21	16	7	40	4	494
1997–98	3	3	6	29	18	4	34	3	468
1998–99	4	4	8	35	6	5	33	5	362
1999–00	3	2	13	29	7	6	37	3	328
2000–01	3	2	10	34	8	4	36	3	320
2001–02	5	1	11	37	0	7	35	3	349

^a Does not include drawing permit hunts

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
JUNEAU, AK 99802-5526

MOOSE MANAGEMENT REPORT

From: 1 July 1999

To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 14B (2152 mi²)

GEOGRAPHIC DESCRIPTION: Western Talkeetna Mountains

BACKGROUND

The first comprehensive moose survey in Unit 14B conducted in the fall 1987 estimated moose numbers at 2814 ± 248 (80% CI) (Masteller 1995). The population declined about 35% following the deep snow winter of 1989–90 (Masteller 1995). By the fall of 1994 the population grew to 2336 ± 527 (80% CI) but the severe winter of 1994–95 probably caused high mortality levels (Masteller 1998). The last survey conducted in the fall 1999 estimated the population at 1687 ± 244 (80% CI).

The moose harvest has decreased dramatically since the 1970s and 1980s. Hunter harvest averaged 96 and 259 moose during the 1970s and 1980s, respectively. Liberal cow seasons allowed peak harvests to reach 372 moose in 1971, 534 in 1984, and 347 moose in 1987 (Griese 1993). There have been no cow seasons since 1987. Since antler restrictions were enacted beginning fall 1993, harvests have averaged 62 moose per year.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

- Produce high yields of moose for humans
- Provide maximum opportunity to hunt moose

MANAGEMENT OBJECTIVE

- Attain a population of 2500–2800 moose, with a sex ratio ≥ 20 bulls:100 cows during the rut
- Achieve an annual harvest of 100–200 moose

METHODS

We generated a population estimate in the fall of 1999 using the Gasaway et al. (1986) stratified random census technique. Surveys were not conducted in 2000 or 2001.

The harvest was monitored with harvest reports and permits from Unit 14B hunters. Successful permit holders were required to provide antlers for measurement and lower front teeth for age determination. The Alaska Railroad Corporation provided numbers of moose killed by trains, and the Department of Public Safety provided numbers of moose killed illegally by highway vehicles or in defense of life or property.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population size

The fall 1999 survey conditions were excellent. The resulting moose population estimate in Unit 14B was 1687 ± 244 (80%CI) (Table 1). However, the winter of 1999–00 had deep snow conditions that contributed to the highest number of road/railroad kills (100) since 1990 (Table 2). The moose population had decreased about 28% since the Becker survey of 1994 and was comparable to levels found in 1990 and 1992, prior to the impacts of the 1999–00 winter. Unit 14B will be surveyed during the fall of 2002.

Population Composition

In our November 1998 survey, we observed 38 bulls and 11 calves:100 cows with 8% of the sampled population being calves (Table 1). The fall 1999 survey estimated 40 bulls and 21 calves:100 cows with 13% of the sampled population as calves (Table 1). The yearling bull:cow ratio was 10:100 in 1998 and 12:100 in 1999.

MORTALITY

Harvest

Season and Bag Limit. The fall 2000 general open season was 10–17 August (for archery-only hunters), 20 August–25 September and 5–15 December for all resident and nonresident hunters. During the 2 early seasons, the bag limit was 1 bull with a spike or fork antler on at least 1 side or with an antler spread at least 50 inches or 3 or more brow tines on at least 1 side (SF50). The late season bag limit was 1 bull with spike or fork antlers only. Sixty drawing permits (DM416) to take any bull were issued for the 1–15 November period.

Board of Game Actions and Emergency Orders. In response to declining moose numbers in Unit 16 and 14B, the Board closed the 2001 general open season in Unit 16B; eliminated the winter hunt (5–15 December) in Units 16A, 14A, and 14B; and eliminated the any-bull permits in 16A (DM556) and 14B (DM416). To help fill some of the lost hunting opportunities through these actions, the general open season was extended 5 days to close on 30 September in Units 16A, 14A, and 14B.

At the spring 2001 meeting, the Board also changed the harvest objective for moose in Unit 14B in light of a long-term decline in moose numbers. The old objective of 200–300 has not been met in over a decade. A more realistic objective of 100–200 moose was set.

Hunter Harvest. Reported harvest has decreased since 92 bulls were taken during 1996–97 (Table 2). Hunters harvested 55 bulls in 2000–01 and 67 bulls in 2001–02. The number of moose

taken under the any-bull permits dropped to 7 animals in 2000–01 which was the last year the permits were issued (Table 3).

Hunter Residency and Success. Local residents of Unit 14 consistently make up the vast majority of the hunter composition (Table 4). The number of hunters has been relatively consistent in the past decade ranging between 314–555 hunters (Table 4). Hunting success rates during the past decade range between 9–16%.

Harvest Chronology. The extended season (25–30 September) accounted for an additional 23 animals taken in 2001–02 (Table 5). No animals were killed during the archery only season (10–17 August) in the past 3 years.

Transport Methods. The elimination of the winter hunt in 2001–02 consequently eliminated the use of snowmachines as a transportation method (Table 6). Four-wheelers and highway vehicles have accounted for a majority of the transportation type used by successful hunters in the past 10 seasons (Table 6).

Other Mortality

Moose killed by auto/train collisions numbered 21 and 41 in 2000–01 and 2001–02, respectively (Table 3). These numbers are at or below the 10 year average of 41 auto/train collisions with moose in Unit 14B (Table 3).

CONCLUSIONS AND RECOMMENDATIONS

Even before the severe winter of 1999–00, the moose population was far below the objective level of 2500–2800. It is not likely that the 2002 survey will find the population near the objective level. The average annual harvest by hunters for the last 3 years was 63, far below the new objective of 100–200. Hunter harvest under the SF/50 regulation is unlikely to reach 100 moose unless antler restrictions are relaxed, access opportunities substantially increase, or the moose population increases.

The SF/50 regulation was adopted for Unit 14B because it shared common boundaries with Units 13A and 14A. Concern for enforcement of the antler restriction along the boundary and the concern for false reporting were principal reasons for its inclusion in the program. Annual movements often carry moose across borders of Units 13E, 16A, 14A, and 14B (Modafferi 1999). Therefore, management decisions for Unit 14B should be made in conjunction with neighboring units.

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Table 1 Unit 14B fall aerial moose composition surveys, 1992–2001

Regulatory year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Adults observed	Moose observed	Observable moose/mi ²	Population estimate ($\pm 80\%$ CI)
1992–93 ^a	27.2	4.4	21.7	14.5	580	659	1.5	1582 \pm 178
1993–94 ^b	--	--	--	--	--	--	--	--
1994–95 ^c	31.1	8.2	17.3	12.0	862	969	2.2	2336 \pm 527
1995–96 ^b	--	--	--	--	--	--	--	--
1996–97 ^b	--	--	--	--	--	--	--	--
1997–98 ^b	--	--	--	--	--	--	--	--
1998–99 ^d	37.5	9.5	11.1	7.5	407	440	--	--
1999–00 ^e	40.2	12.3	21.3	13.2	616	699	1.6	1687 \pm 244
2000–01 ^b	--	--	--	--	--	--	--	--
2001–02 ^b	--	--	--	--	--	--	--	--

^a Data from "Becker Surveys" conducted in November. SCF estimated at 1.40, 1.35 and 1.25 for low, medium, and high density strata, respectively.

^b No surveys conducted.

^c Data from "Becker Surveys" conducted in late October/early November. SCF estimated at 1.00, 1.41 and 1.00 for low, medium and high density strata, respectively.

^d High-grade sex and age composition survey conducted 20 November, 1998.

^e Data from "Gasaway Surveys" conducted in late October/early November. SCF estimated at 1.20, 1.33, 1.15, and 1.03 for low, medium, high, and s-high density strata, respectively.

Table 2 Unit 14B annual moose harvest (general open season plus permit hunts) and accidental death tally, 1992–2001

Regulatory year	Reported			Estimated			Accidental ^d			Total
	M	F	Total ^a	Unreported ^b	Illegal ^c	Total	Road	Train	Total	
1992–93	34	0	34	2	5	7	10	24	34	75
1993–94	30	0	31	3	15	18	15	13	24	73
1994–95	36	0	36	4	15	19	34	56	90	145
1995–96	55	0	55	5	20	25	6	21	27	107
1996–97	92	0	92	9	20	29	10	7	17	138
1997–98	72	2	74	7	20	27	13	14	27	128
1998–99	80	0	80	8	20	28	15	18	33	141
1999–00*	67	0	67	7	20	27	20	80	100	194
2000–01	55	0	55	6	20	26	14	7	21	102
2001–02	67	0	67	7	20	27	31	10	41	135

^a Total includes moose of unknown sex.

^b Derived by taking 5% of the total reported kill prior to SF50 (1993) and 10% after 1993.

^c Includes moose taken in defense of life or property.

^d Road and train are minimum numbers.

* Information updated since last management report.

Table 3 Unit 14B moose harvest permit hunts, 1992–2001

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Total
DM415									
	1995–96	896	100	20	73	6	6	0	6
	1996–97	913	100	16	67	12	12	0	12
	1997–98	949	100	14	73	13	12	1	13
	1998–99	1100	100	20	71	9	7	0	7
	1999–00 ^a	--	--	--	--	--	--	--	--
DM416									
	1995–96	642	30	23	53	23	7	0	7
	1996–97	790	30	10	27	63	19	0	19
	1997–98	783	30	10	47	40	12	0	12
	1998–99	899	30	17	43	40	12	0	12
	1999–00	3778	60	12	60	27	16	0	16
	2000–01	3347	60	25	63	12	7	0	7
	2001–02 ^b	--	--	--	--	--	--	--	--

^a Early season any-bull permits were discontinued as a request by the SF50 Task Force.

^b Any-bull permits were discontinued.

Table 4 Unit 14B moose hunter residency and success for the general open season, 1992–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonres.	Unk.	Total (%)	Local ^a resident	Nonlocal resident	Nonres.	Unk.	Total	
1992–93	31	0	3	0	34 (11)	259	10	5	6	280	314
1993–94	27	1	2	1	31 (10)	279	3	2	11	295	326
1994–95	35	0	1	0	36 (11)	290	8	3	4	305	341
1995–96	36	1	2	3	42 (9)	411	13	5	12	441	483
1996–97	56	2	3	0	61 (12)	471	12	9	4	496	555
1997–98	43	1	5	0	49 (10)	393	18	9	2	422	471
1998–99	55	2	4	0	61 (13)	393	13	12	4	422	483
1999–00*	44	1	4	2	51 (9)	461	7	13	14	495	549
2000–01	40	3	4	1	48 (10)	421	19	14	3	457	505
2001–02	61	2	3	1	67 (16)	329	11	11	3	354	421

^a Unit 14 residents.

* Information updated since last management report.

Table 5 Unit 14B moose harvest chronology for the general open season, 1992–2001

Regulatory year	August			September					November	December		Unknown	Total
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15		
1992–93 ^a	--	--	--	24	5	--	--	--	--	--	--	5	34
1993–94 ^b	--	5	2	5	6	12	--	--	--	--	--	1	31
1994–95 ^b	--	8	1	1	5	19	--	--	--	--	--	2	36
1995–96 ^c	2	3	0	4	9	13	--	--	2	2	7	0	42
1996–97 ^c	0	15	2	3	8	12	--	--	9	1	8	3	61
1997–98 ^c	1	7	1	6	11	9	--	--	3	3	6	2	49
1998–99 ^c	2	6	5	6	6	16	--	--	4	4	7	5	61
1999–00* ^d	0	7	2	3	5	14	9	--	--	3	7	1	51
2000–01 ^d	0	4	0	5	2	15	9	--	--	2	10	1	48
2001–02 ^e	0	10	0	4	6	7	15	23	--	--	--	2	67

^a Open season = Sep 1–10.

^b Open season = Aug 20–Sep 20 (SF/50 –“spike-fork/ 50-inch”).

^c Open season = Aug 10–17 (Archery-only), Aug 20–Sep 20 (Gen.SF/50), Nov 20–Dec 15 (SF-only).

^d Open season = Aug 10–17 (Archery-only), Aug 20–Sep 25 (Gen.SF/50), Dec 5–15 (SF-only).

^e Open season = Aug 10–17 (Archery-only), Aug 20–Sep 30 (Gen.SF/50).

* Information updated since last management report.

Table 6 Unit 14B transport methods used by successful moose hunters during the general open season, 1992–2001

Regulatory year	Percent of successful moose hunters								No. moose harvested
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	
1992–93	26	0	0	41	0	15	15	3	34
1993–94	23	0	6	32	0	10	23	6	31
1994–95	8	6	6	36	0	14	25	6	36
1995–96	12	0	7	36	5	12	26	2	42
1996–97	12	0	5	32	20	6	22	5	61
1997–98	16	2	10	27	12	12	18	2	49
1998–99	8	2	5	36	15	10	20	5	61
1999–00*	18	2	0	29	16	10	24	2	51
2000–01	8	0	4	27	17	19	23	2	48
2001–02	15	2	4	42	0	15	22	0	67

* Information updated since last management report.

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
JUNEAU, AK 99802-5526

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 14C (1,912 mi²) and Portage and Placer river drainages in Unit 7

GEOGRAPHIC DESCRIPTION: Anchorage Area

BACKGROUND

Moose were uncommon in the Anchorage area before the 1940s. They increased in the late 1940s as brushy regrowth replaced mature forests that were cut or burned during the development of Anchorage and the Fort Richardson Military Reservation. Numbers increased considerably during the early 1950s, and by the late 1950s and early 1960s moose were abundant. The moose population has remained high during the past 4 decades.

Prime browse occurs in open-canopied, second-growth willow, birch, and aspen stands on burned-over military lands and on several hundred acres of military lands that have been rehabilitated during the last 2 decades. Parks, greenbelts, and residential areas in the Anchorage Bowl also contain browse. Quality riparian habitat abounds along area streams and rivers. Extensive stands of subalpine willow are on south-facing slopes in most drainages in the area. However, during the last 2 decades, overabundant moose have reduced the distribution and density of browse species.

Annual harvests have fluctuated dramatically in recent decades. A record harvest of nearly 500 moose (50% females) occurred in 1965, while hunters harvested only 18 moose in 1978. Diverse harvests were often due to changes in seasons and bag limits as much as changes in the moose population. Annual harvests increased steadily during the late 1980s and early 1990s but began to decline in 1992. The 5-year mean harvest during this reporting period was 91 moose (22% cows).

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

- Maintain a population of 2000 moose
- Maintain a posthunting sex ratio of no less than 25 bulls:100 cows.

METHODS

We conducted aerial surveys annually (except in 2000) in most hunt areas to estimate sex and age composition during fall and early winter (Table 1). Fall surveys were not flown in 2000 because there was inadequate snow cover until late December or early January, after most bulls had shed antlers. Hunters were required to report their success on either harvest or permit reports, depending on whether they participated in the general season or a special permit hunt. The reports require information on days hunted, hired services, harvest date and location, sex of the animal taken, method of transportation, and antler configuration.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Moose populations were reasonably stable during the 1980s. Population stability was partially due to a series of mild winters beginning in 1979–80.

Moose are adversely affected by snow depths from 70–90 cm (28–36 inches), which impede movement, and depths greater than 90 cm, which restrict movement to the extent that adequate food may be unattainable (Coady 1974). Mean snow depths in Anchorage area lowlands are not normally challenging to wintering moose. Since 1988, however, the Anchorage area has had a series of severe winters. Continued severe winters will exacerbate overbrowsing, which may result in substantial losses of moose in subsequent years.

Deep snows during the winter of 1994–95 caused a substantial decline in the unit's moose population; vehicle collisions and starvation caused most of the known moose mortality. The number of moose killed in collisions with vehicles and trains continued to increase (Table 2). Fall 1996 surveys found the moose population 25–30% below the fall 1994 estimate. With milder winters and a reduction in harvest, the unit's moose population recovered by fall 1998 to near or above the management objective of 2000. Another severe winter in 1998–99 reduced the population to an estimated 1650 by fall 1999. No surveys were conducted in 2000; however, the population has probably rebounded slightly.

Population Size

We estimate a fall 2000 population of 1700–1800 moose in Unit 14C, including the Placer and Portage River drainages (Table 1). About 250 moose inhabit the Anchorage Management Area (excluding the Hillside count area).

Population Composition

The bull:cow ratio ranged from 36:100 to 44:100. It has increased in the Peters Creek and Eklutna/Thunderbird drainages (Table 1). The bull:cow ratio has declined in the Twentymile, Portage, and Placer drainages and in Hunter Creek. The bull:cow ratio was intentionally reduced in the Twentymile, Portage, and Placer drainages to enhance winter survival of cows and calves. There is no clear trend in bull:cow ratios on Fort Richardson and the Hillside area. The percentage of calves in the population ranged from 16–18%. The unit had 9–13 yearling bulls per 100 cows.

Distribution and Movements

Moose are yearlong residents, ranging from sea level to an elevation of 3500 feet. During winters with substantial snow accumulation, most moose are at elevations below 1500 feet. Movements of several miles or more by both sexes occur during the breeding season in late September through October and again before green-up in late March and early April.

MORTALITY

Harvest

Season and Bag Limit. The open seasons for resident and nonresident hunters in the Fort Richardson Management Area were 7 September–15 November and 15 December–15 January in 1999–00, and 5 September–15 November and 15 December–15 January in 2000–01. The bag limit was 1 moose by drawing permit. Hunting in this area was limited to archery only, except in the fall season when muzzleloading rifles were permitted north of Eagle River. We issued 85–96 archery permits and 25 muzzleloader permits for bulls and antlerless moose.

We issued an additional 15 drawing permits for both sexes for Elmendorf Air Force Base in 1999 and 2000. The bag limit was 1 moose, and the season was 7–30 September in 1999 and 5–30 September in 2000. There was no open season in the Anchorage Management Area. The open season for resident and nonresident hunters in the Peters Creek Management Area was 7–30 September in 1999 and 5–30 September in 2000. The bag limit was 1 moose by drawing permit and archery only; 15 permits were issued in 1999 and 2000. The open season for resident and nonresident hunters in the Eklutna Lake Management Area was 7–30 September in 1999 and 5–30 September in 2000. The bag limit was 1 bull by archery only. The hunt was administered by registration permit with a quota of 4 bulls.

The open season for resident hunters in the remainder of Unit 14C was 7–25 September in 1999 and 5–25 September in 2000. The bag limit was 1 bull moose with spike-fork/50-inch antlers; however, hunters could take antlerless moose by drawing permit only (50 and 40 permits were issued in 1999 and 2000, respectively). The open season for the Twentymile River area was 20 August–30 September in 1999 and 2000. The bag limit was 1 bull by drawing permit with 35 permits issued in 1999 and 10 permits in 2000.

Board of Game Actions and Emergency Orders. In 1995 and 1996 the Board of Game considered several proposals for a moose hunt in the Anchorage Management Area but delayed a final decision until the March 1997 meeting in Anchorage. In March 1997 the board considered several proposals for hunting with shotguns and muzzleloaders in Chugach State Park and bow hunts in several municipal parks. None were approved. However, the Board of Game finally authorized a moose hunt for antlerless moose and spike-fork bulls in the upper Campbell, Rabbit and Potter Creek drainages (DM666) in March 1999. No permits have been issued because the Division of Parks and Outdoor Recreation continued to prohibit discharge of firearms in these drainages. Beginning in 1998, only Alaska residents could obtain an antlerless moose permit in the remainder of Unit 14C. In March 1999 the Board of Game extended the season for the Eklutna Management Area to October 20 to allow bowhunting during the rut, and extended the general season moose hunt from September 20 to September 25. All antlerless moose hunts were reauthorized annually, except DM666 beginning in 2001.

An emergency order closed the moose hunting season in the Eklutna Management Area (RM445) effective October 3, 2000, when the quota of 4 moose was achieved. An emergency order closed the moose hunting season in the Eklutna Management Area (RM445) effective September 21, 2001, when the quota of 2 moose was achieved. The 2001 quota had been reduced from 4 to 2 moose because 5 moose were harvested and 1 mortally wounded during the 2000 season. An emergency order opened the moose hunting season on Elmendorf Air Force Base (DM428, DM429) from December 15, 2001, to January 15, 2002. The Board of Game authorized this action because Elmendorf Air Force Base was closed to public access from September 11, 2001, through the remainder of the fall hunting season, due to national security issues. The Board also authorized reissuing drawing permits to Fort Richardson hunters (DM422–DM425) who could not gain access to the military reservation after September 11, 2001. Permits for the 2001 hunting season were reissued to the same hunters in 2002, unless they had harvested a moose on Fort Richardson or were unable to participate.

The Board revised 5 AAC 92.230 (Feeding of game). Effective July 1, 2002, it is illegal to negligently leave human food, pet food, or garbage in a manner that attracts moose. The previous wording was “intentionally” rather than “negligently.” Initially the fine was \$50, but it was increased to \$100 in September 2002.

Hunter Harvest. During the 1999–00 and 2000–01 seasons, 73 and 87 moose were harvested, respectively, with a 2-year mean of 62 bulls and 18 cows (Table 2). Approximately 31% of the bulls were taken during the general season. The remaining moose were taken in permit hunts.

Permit Hunts. During the 1999–00 season, we issued 546 permits to hunt moose in Unit 14C. Of these, 51 hunters (14%) were successful. In 2000–01, 420 permits were issued, and 70 hunters (26%) were successful (Table 4). Drawing permit hunts were very popular. In 1999, there were 9220 hunters who applied for 235 drawing permits (2059 applicants for the 35 permits for the Placer/Twentymile hunts and 1615 applicants for the 20 antlerless permits in Hunter/Knik drainages). In 2000, there were 8647 applicants for 200 drawing permits (1677 for the 10 permits for the Placer/Twentymile hunts). Additionally 311 hunters in 1999, and 220 hunters in 2000 received registration permits for the Eklutna Valley archery hunt. The number of permittees increased in 1999 due to a hunting extension of 1 month, which allowed bowhunters to call moose during the peak of the rut. Despite its popularity, the success rate for this hunt, 1–5% in the late 1990s (Table 4), remains low. The high number of unsuccessful bowhunters in this hunt was partly responsible for the low success rate (14%) for all permit hunts, compared with other years (23–26%; Table 4).

Hunter Residency and Success. Residents of Unit 14 accounted for 88% of the moose harvested in Unit 14C in 1999 with nonresidents taking 6%. In 2000, residents accounted for 92% and nonresidents took 2% of the total harvest (Table 3). As predicted, the regulation that reserved local drawing permits for Alaskan hunters beginning in 1998 did not affect success rates.

Harvest Chronology. It is difficult to compare annual harvests for the first week in September (Table 5) because season opening dates are variable (i.e., the day after Labor Day). In 1990, after the general season was shortened by 10 days (from 30 September to 20 September), harvests shifted primarily to the second week in September, rather than being compressed into the third week, as might be expected (Table 5). The second week in September is essentially the

opening week of moose hunting for much of the unit when the day after Labor Day is later than usual (e.g., 8 September in 1998). On the other hand, when the general season was extended from September 20 to September 25 (e.g., 1999 and 2000), about one-fourth to one-third of hunters harvested a bull in the last few days of the season. A permit archery hunt was held on military land from mid-December through mid-January, after many moose summering in the Fort Richardson-Elmendorf-Ship Creek area became accessible in lowland areas of Fort Richardson.

Transport Methods. Approximately two-thirds of all successful moose hunters reached their kill sites by highway vehicle (Table 6). The high proportion of walk-in hunters is due to proximity of many moose to roads and trails and the prohibition of motorized off-road vehicles and airplanes in most of Chugach State Park.

Other Mortality

Moose killed by vehicles and trains accounted for 54–63% of known, human-caused mortality during the reporting period. Vehicles killed at least 239 moose and trains killed 22 in 1994–95, a record high because of near-record snow depths that forced many moose into town. During this report period, a mean of at least 163 moose were killed in vehicle and train collisions annually (Table 2). These are conservative figures because not all collisions are reported and some moose, never found, die from injuries.

Natural mortality was low in the Anchorage area from the mid-1950s to the late 1980s because of moderate annual snowpack and relatively low numbers of predators. More moose have starved in recent winters due to 1) greater than average snowpack that cover potential browse and require greater expenditure of energy and 2) overbrowsing in previous winters. In recent years, 2 packs of wolves have occupied the Knik and Twentymile River drainages.

HABITAT

Assessment

Large tracts of subalpine and riparian habitat are protected throughout the 500,000-acre Chugach State Park and Chugach National Forest land between Girdwood and Portage. Several thousand acres of lowland habitat are on military lands between lower Ship Creek and Eagle River. Extensive urbanization has reduced winter range on portions of the military reservation and on private lands throughout the unit. Roads and trails associated with development, however, provide movement corridors, which reduce energy expenditures for moose during years of heavy snowfall.

Enhancement

Extensive habitat enhancement on military, state, and municipal lands is not economically feasible because burning, the most cost-effective method, is difficult to do safely in a densely populated area. Habitat enhancement is not a desirable alternative in Chugach State Park. Chugach National Forest staff enhanced moose habitat in a limited area near Portage, primarily to enhance viewing opportunity. Winter habitat will inevitably decrease over time in the Anchorage area, as will the number of moose that depend on winter habitat.

CONCLUSIONS AND RECOMMENDATIONS

One population objective was met. The bull:cow ratio exceeded 25:100. However, the fall 2000 population was estimated at 1700–1800 moose, below the management objective of 2000 moose. Following 1–2 mild winters, the population should rebound to meet the management objective.

Existing management programs were developed in cooperation with staffs from Fort Richardson, Elmendorf Air Force Base, and Chugach State Park. Through restrictions on harvest methods and compromises on open and closed areas, management regimes have been developed and are acceptable to all parties.

Current regulations adequately address management concerns by providing for substantial hunting opportunities and harvests from a productive moose population in an area where several land management agencies have limited access modes.

Nuisance moose in residential areas remain a significant problem. The Alaska Department of Transportation and Public Facilities estimated rural moose-vehicle collisions cost an average of \$15,150 for vehicle repairs; emergency, medical, and legal services, and lost wages (ADOTPF 1995). Moose-vehicle collisions may cost Anchorage residents \$2.4 million/year, based on the number of moose-vehicle collisions reported during this 5-year report period. Moose also cause considerable damage to ornamental plants, vegetable gardens, and fruit trees in winter and spring. Some residents continue to feed local moose, despite the regulation prohibiting feeding, and when a handout is not immediately forthcoming, these moose can be unusually aggressive toward people. Area staff spends considerable time listening and responding to complaints about property damage, public safety, and injured moose. On the other hand, residents tolerate much damage, and most residents and visitors consider moose a desirable species. Public education regarding moose behavior and biology may improve public tolerance and reduce conflicts (Whittaker et al. 2001).

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Table 1 Unit 14C fall aerial moose composition counts and estimated population size, 1996–2001

Area	Regulatory year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Total moose observed	Moose /hour	Estimated population size ^a
Twentymile River	1996–97	37	11	40	23	168	56	250
Portage River	1997–98	30	9	47	27	173	57	
Placer River	1998–99	24	4	30	19	181	48	240
	1999–00	18	4	23	16	116	35	135
	2000–01 ^b	--	--	--	--	--	--	
Hillside	1996–97	30	11	40	23	90	47	125
	1997–98	44	5	38	21	212	77	
	1998–99	29	13	36	22	213	70	280
	1999–00	35	7	35	21	145	51	170
	2000–01 ^b	--	--	--	--	--	--	
Anchorage Bowl (except Hillside)	1996–97	--	--	--	--	--	--	200 ^c
	1997–98	--	--	--	--	--	--	
	1998–99	--	--	--	--	--	--	300 ^c
	1999–00	--	--	--	--	--	--	250 ^c
	2000–01 ^b	--	--	--	--	--	--	
Fort Richardson	1996–97	57	10	31	16	294	24	340
Elmendorf AFB	1997–98	59	12	33	17	356	36	
Off-base Ship Cr.	1998–99	42	13	32	18	386	32	503
	1999–00	57	24	31	16	408	31	474
	2000–01 ^b	--	--	--	--	--	--	

Table 1 Continued

Area	Regulatory year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Total moose observed	Moose /hour	Estimated population size ^a
Eagle River	1996–97	--	--	--	--	--	--	120
	1997–98	--	--	--	--	--	--	
	1998–99	36	6	22	14	101	--	130
	1999–00	--	--	--	--	--	--	110
	2000–01 ^b	--	--	--	--	--	--	
Peters Creek	1996–97	44	11	39	21	33	19	50
	1997–98	52	4	11	7	45	25	
	1998–99	73	16	16	9	69	24	90
	1999–00	95	11	26	12	42	19	50
	2000–01 ^b	--	--	--	--	--	--	
Eklutna River Thunderbird Cr.	1996–97	--	--	--	--	--	--	110
	1997–98	--	--	--	--	--	--	
	1998–99	18	0	24	17	48	13	60
	1999–00	28	6	22	15	48	12	55
	2000–01 ^b	--	--	--	--	--	--	
Bird Creek Indian River ^d	1996–97	--	--	--	--	--	--	100
	1997–98	--	--	--	--	--	--	
	1998–99	--	--	--	--	--	--	150
	1999–00	--	--	--	--	--	--	120
	2000–01 ^b	--	--	--	--	--	--	

Table 1 Continued

Area	Regulatory Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Total moose observed	Moose /hour	Estimated population size ^a
Hunter Creek Knik River	1996–97	27	6	15	13	112	45	150
	1997–98	33	12	16	10	165	47	
	1998–99	36	0	27	16	104	52	140
	1999–00	23	4	12	9	123	37	145
	2000–01 ^b	--	--	--	--	--	--	
Lake George	1996–97	--	--	--	--	--	--	
	1997–98	43	6	14	9	132	--	170
	1998–99	--	--	--	--	--	--	165
	1999–00	--	--	--	--	--	--	140
	2000–01 ^b	--	--	--	--	--	--	
Unit 14C Total	1996–97	42	10	31	18	697	32	1450
	1997–98	44	9	30	17	1083	45	
	1998–99	36	9	30	18	1102	35	2100
	1999–00	41	13	26	16	882	31	1650
	2000–01 ^b	--	--	--	--	--	--	

^a Estimate based on most recent count, using sightability index of 0.77 (based on Fort Richardson estimate calculated with MOOSPOP). Estimates in unsurveyed drainages are extrapolated based on trends in adjacent count areas.

^b Fall surveys not conducted due to lack of snow.

^c No aerial surveys; estimate is best guess.

^d Last surveyed in 1988.

Table 2 Unit 14C moose harvest and accidental death, 1996–2001

Regulatory year	Hunter harvest						Accidental death ^b			
	Reported			Estimated						Total
	M (%)	F (%)	Total ^a	Unreported	Illegal	Total	Road	Train	Total	
1996–97	88 (85)	16 (15)	104	10	10	20	136	11	147	271
1997–98	72 (76)	23 (24)	95	10	10	20	137	10	147	262
1998–99	72 (74)	25 (26)	97	10	10	20	152	6	158	275
1999–00	61 (84)	12 (16)	73	10	10	20	150	11	161	254
2000–01	63 (72)	24 (28)	87	10	10	20	160	5	165	272

^a Includes those with unreported sex.

^b Reported deaths only.

Table 3 Unit 14C moose hunter residency and success, 1996–2001

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident ^a	Nonlocal resident	Nonresident	Total (%) ^b	Local resident ^a	Nonlocal resident	Nonresident	Total (%) ^b	
1996–97	86	14	2	104 (21)	352	22	4	381 (79)	485
1997–98	87	5	3	95 (21)	345	20	4	369 (79)	464
1998–99	94	1	2	97 (19)	418	7	3	428 (81)	525
1999–00	64	5	4	73 (14)	437	19	4	461 (86)	534
2000–01	80	5	2	87 (20)	320	17	6	347 (80)	434

^a Residents of Unit 14 (majority from Unit 14C).

^b Includes hunters with unspecified residency.

Table 4 Unit 14C moose harvest data by permit hunt, 1996–2001

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Total harvest ^a
DM210, 211	1996–97	50	10	47	53	88	12	24
Twentymile	1997–98	45	9	54	46	79	21	19
Portage	1998–99	50	16	57	43	100	0	18
Placer	1999–00	35	54	100	0	0	0	0
	2000–01	10	40	83	17	100	0	1
DM424,425,427	1996–97	85	7	65	35	89	11	28
Fort Richardson	1997–98	96	10	50	50	72	28	43
(archery only)	1998–99	95	14	61	39	75	25	32
	1999–00	95	14	65	35	72	28	29
	2000–01	95	16	50	50	73	27	40
DM422,423	1996–97	25	0	68	32	88	12	8
Fort Richardson	1997–98	25	24	100	0	0	0	0
(muzzleloader)	1998–99	25	20	72	28	67	33	6
	1999–00	25	8	61	39	89	11	9
	2000–01	25	16	67	33	57	43	7
RM445 ^b	1996–97	182	29	97	3	100	0	4
Eklutna	1997–98	190	33	99	1	100	0	1
(archery only)	1998–99	161	35	97	3	100	0	3
	1999–00	311	22 ^c	98	2	100	0	3
	2000–01	220	51 ^d	95	5	100	0	5

Table 4 Continued

Hunt no. /Area	Regulatory Year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Total harvest ^a
DM441 Hunter Knik	1996–97	5	0	40	60	0	100	3
	1997–98	5	0	100	0	0	0	0
	1998–99	20	15	59	41	17	83	7
	1999–00	20	5	95	5	0	100	1
	2000–01	10	0	70	30	0	100	3
DM428, 429 Elmendorf AFB (archery only)	1996–97	15	7	14	86	67	33	12
	1997–98	15	0	33	67	50	50	10
	1998–99	15	7	43	57	50	50	8
	1999–00	15	7	50	50	86	14	7
	2000–01	15	7	50	50	57	43	7
DM442 Ship	1996–97	10	20	88	12	0	100	1
	1997–98	10	30	86	14	0	100	1
	1998–99	10	50	80	20	0	100	1
	1999–00	20	30	93	7	0	100	1
	2000–01	20	20	81	19	0	100	3
DM443 Peters and Little Peters	1996–97	10	30	86	14	0	100	1
	1997–98	10	30	100	0	0	0	0
	1998–99	10	10	78	22	0	100	2
	1999–00	10	20	100	0	0	0	0
	2000–01	10	30	86	14	0	100	1

Table 4 Continued

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Total harvest ^a
DM448, 449 Birchwood ^c (archery only)	1996–97	15	33	90	10	100	0	1
	1997–98	15	20	92	8	0	100	1
	1998–99	15	7	79	21	33	67	3
	1999–00	15	20	92	8	100	0	1
	2000–01	15	27	73	27	100	0	3
Totals for all permit hunts	1996–97	397	19	75	25	81	19	82
	1997–98	411	22	77	23	69	31	75
	1998–99	401	23	74	26	69	31	80
	1999–00	546	31	86	14	77	23	51
	2000–01	420	35	74	26	66	37	70

^a Includes moose with unspecified sex.

^b Registration hunt.

^c Includes 58 permittees who did not report.

^d Includes 108 permittees who did not report.

Table 5 Unit 14C moose harvest^a chronology, 1996–2001

Regulatory year	Percent of harvest					n
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	
1996–97 ^b	24	48	29	--	--	21
1997–98 ^c	30	40	30	--	--	20
1998–99 ^d	--	56	44	--	--	16
1999–00 ^e	5	32	27	36	--	22
2000–01 ^f	20	33	20	27	--	15

^a Excludes permit hunt harvests.^b Season 9/3–9/20^c Season 9/2–9/20^d Season 9/8–9/20^e Season 9/7–9/25^f Season 9/5–9/25

Table 6 Unit 14C moose harvest percent by transport method, 1996–2001

Regulatory year	Percent of harvest								n
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle	Unknown	
1996–97	8	4	24	1	0	0	63	1	104
1997–98	7	3	11	1	1	2	71	3	88
1998–99	2	5	10	2	0	6	71	3	87
1999–00	4	4	1	1	0	1	86	3	73
2000–01	2	1	6	0	0	2	84	5	87

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 15A (1314 mi²)

GEOGRAPHIC DESCRIPTION: Northern Kenai Peninsula

BACKGROUND

Historical records and reports from residents indicate moose were abundant throughout the century in Unit 15A. The most recent population peak occurred in 1971. The near absence of wolves from 1913 to 1968, and increased moose survival following a 500-mi² forest fire in 1947 were 2 events that increased moose numbers throughout the 1950s and 1960s. Although seasons were long and either-sex harvest was allowed, the moose population increased beyond its carrying capacity and extensive overbrowsing occurred by the late 1960s. A wildfire in 1969 burned approximately 135 mi² (11 percent of 15A), initially reducing moose habitat in 15A, then harsh winters from 1971– 1974 reduced the moose population over the entire Kenai Peninsula. Estimates for Units 15A and 15B indicate the combined population estimate declined from 7900 in 1971 to 3375 by 1975. Unit 15A represents 75% of these estimates, a decline from 5900 to 2500 moose. By 1982, following more favorable winters, the moose population estimate for 15A increased to 3000.

In 1987 and 1990 estimation methods described by Gasaway (1986) were used in the unit for the first time. They indicated a stable population trend in the range of 3014–3850 moose. In February 2001, we completed a moose census using methods developed by VerHoef. Using VerHoef's modified Gasaway census technique we estimated the moose population in Subunit 15A at 2097 (95% confidence intervals 1704–2431). The winters of 1998–99 and 1999–00 were classified as severe for 15A with snow accumulation up to 40 inches. We believe the moose population was reduced by these severe winters between 30 to 39 percent, resulting in a current population estimate of 2100.

No large wildfires have occurred since the fires in 1947 and 1969 on the Kenai Peninsula. Consequently, less browse associated with successional forest stages was available to moose and a gradual decline in moose population size is anticipated during normal winters. Small wildfires and intentional habitat improvement efforts have temporarily reversed this general trend in local areas.

Increased human presence and impact of the Alaska National Interest Lands Conservation Act on the Kenai Peninsula have increased the necessity for cooperative interagency management of renewable resources. To this end, the department works closely with a variety of agencies and landholders, while still clearly retaining management authority for wildlife on nonfederal lands and nonsubsistence wildlife species on federal lands. The Kenai National Wildlife Refuge is the largest landholder in Unit 15A and actively participates in a variety of cooperative moose management programs. These include support of the ADF&G Moose Research Center near Sterling, cooperative management of Skilak Loop as a wildlife viewing area, and recent attempts to provide increased access for hunters in wheelchairs. Close coordination and cooperation should continue.

A selective harvest strategy with a spike/fork-50 inch bag limit was initiated on the Kenai Peninsula in 1987. The proportion of males in the population has subsequently increased, and hunters seem generally satisfied with the selective harvest strategy. We completed a 5-year evaluation of selective harvest on the Kenai in 1992, and a 10-year evaluation in 1999.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Maintain a healthy population of moose with a posthunting bull-to-cow ratio of at least 15:100 in Unit 15A, excepting the Skilak Loop Wildlife Management Area (SLWMA).

Primary moose management objectives in Skilak Loop Wildlife Management Area (SLWMA) are listed:

- View moose in a natural setting throughout the year.
- Provide opportunities to view all components of the moose community, including their behavior and habitat.
- Provide opportunities to harvest moose when a reduction in numbers is desirable to achieve other objectives.
- Achieve and maintain the resident population at 130 animals or a density of 1.8 to 2.0 moose per mi². Resident moose in excess of 130 will be available for harvest.
- Increase the bull-to-cow ratio to at least 40 bulls:100 cows.

In addition to the resident population, moose from surrounding areas commonly winter in SLWMA. Winter populations reach 300 animals. Habitat will be managed to provide for 130 resident and up to 170 additional wintering moose.

METHODS

We conducted aerial surveys in November and December of each year in selected trend count areas to ascertain sex and age composition. In 1999 and 2000 weather conditions were not suitable to conduct fall sex and age composition surveys.

A population estimate for Unit 15A was developed from data collected in February 2001. Jay Ver Hoef (ADFG Fairbanks Biometrician) developed the techniques used for S-Plus Spatial Statistics.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The February 2001 estimate for moose wintering in the unit was $2097 \pm 15.9\%$ (1704–2431) at the 95% CI. The February 1990 estimate for moose wintering in the unit was $3432 \pm 12.18\%$ (3014–3850) at the 90% CI. These data indicated a decline of approximately 39 percent of the mean; however, it is believed that most of this decline occurred during the severe winters of 1998–99 and 1999–00.

Population Composition

Poor weather and lack of complete snow cover prevented us from completing a fall sex and age composition survey in 1999 and 2000. In 1998, we observed 1528 moose in fall composition surveys, compared to 1467 in 1996 (Table 1). Calves composed 17% of the 1998 sample and occurred in the proportion of 27:100 cows. Calf composition data declined compared to data from 1992 to 1996; however, calf survival was high the previous year. Subsequently, there were a substantial number of nonproductive yearling cows in 1998. Bulls were observed at a ratio of 31:100 cows, 5 bulls:100 cows more than in 1996. Yearling bulls increased from 8:100 cows in 1996 to 11:100 cows in 1998, after the mild winter of 1997–98. The winter of 1998–99 was extremely harsh: 161 moose, primarily calves, died from starvation, part of a large number of animals that succumbed to the winter.

MORTALITY

Harvest

Season and Bag Limit. The general open season in Unit 15A was from August 20 to September 20. In spring of 1995 the Board of Game approved an archery season for Unit 15A with a season from August 10 to 17. Archery hunters were restricted to the same bag limit used during the general season. The bag limit was 1 bull with spike/fork or 50-inch antlers or at least 3 brow tines on at least 1 antler. Forty permits were issued in a drawing permit hunt in Skilak Loop Wildlife Management Area for antlerless moose in 1999–00 and 20 permits for spike/fork bulls. The antlerless season was from September 15–30 and the spike/fork bull season from September 21–30. The bag limit for the antlerless season prohibited harvesting of calves and females with calves. These permit hunts were not held during the fall 2000 season.

Board of Game Actions and Emergency Orders. There was no Board of Game action taken during this reporting period.

Hunter Harvest. In 1999, 1195 hunters harvested 92 moose (88 bulls and 4 of unreported sex) during the nonpermit seasons (Tables 2 and 5). The 1999 harvest declined by 66% compared to

the 1998 harvest of 271 moose. This reduction in harvest reflects severe winter losses sustained by the 15A moose population from deep snows during the winter of 1998–99.

In 2000, 1162 hunters harvested 131 moose (130 bulls and 1 of unspecified sex) during the nonpermit seasons. The 2000 harvest increased by 30% compared to 1999.

Results of an August 10–17 archery season were included in the total harvest figures for Unit 15A. However, information requested on harvest ticket reports did not include the time spent hunting by unsuccessful hunters; therefore, it was not possible to determine how many hunters went afield during the archery season. Data collected at field checkstations were used to estimate hunter participation. An estimated 200 to 250 archery hunters participated during the 10–17 August 1999 and 2000 archery-only hunts in 15A. They reported a harvest of 16 bulls (17%) in 1999 and 11 bulls (8%) in 2000. Archers, hunting under the spike/fork-50-inch antler restriction, harvested primarily bulls in the spike/fork category.

Of the 92 moose harvested in 1999, 71 (77%) were reported with antler-spread data. Because the current bag limit was designed to focus harvest on a portion of the yearlings and on mature bulls, we assumed that bulls <35-inch antler spread met the yearling (spike/fork) requirement and ≥ 35 -inch spreads were mature bulls (having 3 brow tines or an antler spread >50 in.). Forty-eight percent ($N = 34$) of the harvest were spike/fork bulls and 52 percent ($N = 37$) were mature bulls. Eighteen percent ($N = 13$) of the reported harvest were bulls with an antler spread ≥ 50 -inches. In 2000, the harvest comprised 62 (50%) yearlings and 61 (50%) mature bulls. Twenty-eight percent ($N=35$ of 123) of the bulls were ≥ 50 inches.

Federal subsistence hunters, whose season began on 18 August, harvested no moose during the August 18 and 19 season in the past four years.

Permit Hunts. The antlerless permit hunt in SLWMA was held in 1999 but was not allowed in 2000. There were 1570 applicants for 40 permits to hunt antlerless moose, and 35 of the permit winners hunted, harvesting 8 moose (Table 3). There were 740 applicants for 20 permits for spike/fork bulls in SLWMA in 1999; the season was not open in 2000. Twelve permit holders hunted in 1999 but none were successful (Table 4). All moose harvested in the antlerless hunt were females.

Hunter Residency and Success. The 1999 hunter success was 8%, compared to 19% in 1998. In 1999, 79 successful hunters (86%) were unit residents, 9 (10%) were non-unit residents, and 4 (4%) were nonresidents ($N = 92$). Residency reported for unsuccessful hunters was as follows: unit residents 954, non-unit state residents 131 and nonresidents 18. (Table 5). Successful hunters averaged 6.7 days, compared to 9.0 days for all hunters.

The 2000 hunter success was 11%, compared to 8% in 1999. In 2000, 106 (81%) successful hunters were unit residents, 20 (15%) were non-unit residents, and 5 (4%) were nonresidents ($N = 131$). Residency reported for unsuccessful hunters was as follows: unit residents 835, non-unit state residents 177 and nonresidents 19. (Table 5). Successful hunters averaged 6.2 days, compared to 7.6 days for all hunters.

Transport Methods. Fifty-four percent of the 1999 successful hunters reported highway vehicles as their primary means of transportation. Boats were the second most common (17%) means of transportation and 4-wheelers third (12%). Hunters using aircraft, ORVs, and horses accounted for 9% of the reported harvest combined.

The 2000 transportation data compared closely with 1999, when 66% of successful hunters reported using highway vehicles (Table 6). In 2000, aircraft were used by 4%, compared to 12% for 4-wheelers. ORVs and horses only made up 5% of the total means of transport use.

Harvest Chronology. Sixteen percent of the 1999 and 11% of the 2000 harvest occurred during the August 10–17 archery season (Table 7). Seventeen percent of the 1999 and 24% of the 2000 harvest occurred during the first 5 days of the general hunt season. The highest percentage of harvest in 1999 (18%) and 2000 (28%) occurred during the last 5 days of the general season.

Other Mortality

Crippling loss by hunters and loss to predation was unknown. In 1999, 81 moose were reported killed in 15A by vehicle/wildlife accidents, compared to 59 in 2000 (Table 2). About 50% of moose killed by vehicles each year are calves. Between 1992 and 1998, an average of 131 moose were killed in wildlife/vehicle accidents in Unit 15A compared to a mean of 70 over the past two years. The significant reduction in number of moose killed resulted from the overall reduction in the moose population during these severe winters. A public awareness program, begun in 1990 to reduce the number of vehicle/wildlife collisions (Del Frate and Spraker 1991), has failed to demonstrate a significant reduction in accidents.

HABITAT

Assessment

The 1969 burn (85,000 acres) is still providing browse for most of the moose wintering in Unit 15A. However, this area and small areas of improved habitat north of Skilak Lake compose only 10–15% of moose habitat in the unit. The remaining moose habitat is unproductive due to forest succession and browse heights not optimal for moose.

Enhancement

In May 1991, approximately 8320 acres burned in the southeastern portion of 15A near Pothole Lake. This burn is expected to increase available moose habitat; however, this may only benefit animals in the immediate area of the burn due to its small size. Substantial statewide publicity regarding beneficial effects of wildfire for forest succession wildlife stemmed from the Pothole Lake fire.

A 10,369-acre area in the Mystery Creek Road vicinity was to be burned by U.S. Fish and Wildlife Service in the fall of 1991. Unfavorable weather conditions and other factors prevented this prescribed burn project until July 1999 when a small portion of the area was burned. Approximately 40% of this area was scheduled to be left untreated as scattered islands for wildlife cover and as a seed source for revegetation.

CONCLUSIONS AND RECOMMENDATIONS

Kris Hundertmark (ADFG) completed a 10-year review of the selective harvest strategy in 1999. The bull-to cow-ratio increased from a 5-year (1982–86) average of 13:100 to 22:100 in 1991, but declined to 16:100 in 1992 following the severe winter of 1991–92. In 1994–95 the ratio rebounded to 24:100 and remained relatively stable at 26:100 in the 1996 and 1997 fall composition surveys. In 1998 the ratio increased to 31:100.

Composition surveys were not completed during this two-year reporting period. Low recruitment following the severe winters of 1998–99 and 1999–00 reduced the number of bulls available for harvest and hunter effort due to the perceived low probability of success. Over the past 5 years, hunter effort has averaged 1306 hunters per season, ranging from 1162 to 1424. The interest in archery hunting has also remained high with the archers taking 16% and 11% of the harvest in the past 2 years, respectively.

With the increase in the number of bulls, the opportunity for viewing and photography has increased. Public perception of improved population health and the need for public support for continuation of the program has also widened.

During the past 10 years, 5 severe winters, 1991–92, 1994–95, 1996–97, 1998–99, and 1999–00 have affected moose numbers in Unit 15A. The number of available bulls following these winters declined, as did the harvest. In 1999–00, the harvest declined 66% compared to the previous year. In 2000–01, following a second severe winter and low survival, the harvest rebounded by only 30%. In 1999, hunter success decreased because very few yearling moose were available to hunters. The number of moose killed by automobiles also declined. The reduction was caused by a reduced moose population size.

Unlike other game management units in Alaska, no emergency reduction in the 1999–00 or 2000–01 moose seasons or bag limit was necessary due to effects of the previous winters. In addition to a reduction in harvest after a severe winter, the number of hunters has also decreased. The conservative nature of the spike-fork/50-inch bag limit on the Kenai Peninsula allowed the department to continue to offer the same recreational opportunity as in previous years. No changes in management objectives or bag limits are recommended at this time.

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Table 1 Unit 15A aerial moose composition counts and estimated population size, 1992–00

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	Total moose observed	Moose /hour	Estimated population size
1992–93	16	5	36	23	1019	1331	--	
1993–94 ^a								
1994–95	24	9	32	20	955	1199	--	
1995–96 ^a								
1996–97	26	8	39	24	1120	1467	--	
1997–98 ^a								
1998–99	31	11	27	17	1269	1528	--	3000–3800
1999–00 ^a		No Surveys						
2000–01 ^a		No Surveys						1700–2450

^a No data available.Table 2 Unit 15A moose harvest^a and accidental death, 1992–00

Regulatory year	Hunter Harvest							Accidental death			Grand total
	Reported				Estimated						
	M(%)	F (%)	Unk.	Total	Unreported	Illegal	Total	Road	Train	Total	
1992–93	141	2	0	143			40	99	0	99	282
1993–94	229	2	1	232			40	119	0	119	391
1994–95	233	2	3	238			40	168	0	346 ^b	584
1995–96	115	0	2	117			40	90	0	90	247
1996–97	257	0	3	260			40	160	0	160	460
1997–98	187	0	4	191			40	143	0	143	374
1998–99	264	0	7	271			40	138	0	138	449
1999–00	88	0	4	92			40	81	0	81	213
2000–01	130	0	1	131			40	59	0	59	230

^a Excludes permit hunt harvest.^b 178 moose died due to starvation during winter.

Table 3 Unit 15A harvest data by permit hunt DM524, Skilak Loop Antlerless Moose, 1990–00

Hunt No. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk.	Total harvest
DM524	1990–91	20	15	50	35	0	7	0	7
Skilak	1991–92	20	0	45	55	0	11	0	11
Loop	1992–93	20	0	70	30	0	6	0	6
Antlerless	1993–94	30	7	62	38	0	10	0	10
	1994–95	30	13	50	50	0	13	0	13
	1995–96	40	20	78	22	0	7	0	7
	1996–97	No	Season						
	1997–98	No	Season						
	1998–99	40	10	69	31	0	11	0	11
	1999–00	40	13	77	23	0	8	0	8
	2000–01	No	Season						

Table 4 Unit 15A harvest data by permit hunt DM526, Skilak Loop Spike/Fork Moose, 1995–00

Hunt Nr /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk.	Total harvest
Skilak	1995–96 ^a	20	35	92	8	1	0	0	1
Loop	1996–97	No	Season						
Spike/	1997–98	20	35	92	8	1	0	0	1
Fork	1998–99	No	Season						
	1999–00	20	40	100	0	0	0	0	0
	2000–01	No	Season						

^a First year of Spike/Fork season in Skilak Loop.

Table 5 Unit 15A moose hunter^a residency and success, 1992–00

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Total(%)	
1992–93	121	14	2	143 (12)	874	171	15	1064	1207
1993–94	193	27	8	232 (16)	968	193	13	1195	1427
1994–95	197	30	5	238 (17)	943	204	15	1187	1425
1995–96	99	13	4	117 (10)	871	133	11	1018	1135
1996–97	208	41	9	260 (19)	1005	136	19	1164	1424
1997–98	163	24	2	191(14)	974	144	18	1140	1331
1998–99	239	26	3	271(19)	988	138	17	1147	1418
1999–00	79	9	4	92(08)	954	131	18	1103	1195
2000–01	106	20	5	131(11)	835	177	19	1031	1162

^a Excludes hunters in permit hunts.^b Local = residents of Unit 15.Table 6 Unit 15A moose harvest^a percent by transport method, 1992–00

Regulatory year	Percent of harvest							Unknown	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle		
1992–93	13	3	12	5	0	4	59	4	143
1993–94	10	2	12	4	0	7	59	6	232
1994–95	6	1	15	6	0	4	63	4	238
1995–96	9	3	17	8	0	2	57	4	117
1996–97	6	3	11	8	0	2	66	4	260
1997–98	3	2	14	7	0	4	69	2	191
1998–99	3	1	7	9	0	3	72	6	271
1999–00	8	1	17	12	0	5	54	2	92
2000–01	4	2	11	12	0	3	66	2	131

^a Excludes permit hunt harvest.

Table 7 Unit 15A moose harvest^a chronology percent by harvest periods, 1992–00

Regulatory year	Harvest periods							Unk	n
	8/10–8/19	8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20		
1992–93	--	--	8 ^b	33 ^c	18	13	25	4	143
1993–94 ^d	--	35	7	10	8	13	23	5	232
1994–95 ^d	--	34	11	8	6	15	21	6	238
1995–96	11 ^e	20	10	10	9	15	21	5	117
1996–97	12 ^e	26	10	6	7	18	18	4	260
1997–98	20 ^e	24	5	6	7	16	17	5	191
1998–99	17 ^e	23	8	8	8	15	13	8	271
1999–00	16	17	5	12	12	16	18	4	92
2000–01	11	24	7	8	8	13	28	2	131

^a Excludes permit hunt harvest.

^b Archery season - 8/25–29, 92; 8/10–17, 95 and 96, S/F-50”.

^c General open season Sep 1–Sep 20; S/F-50”.

^d General open season Aug 20–Sep 20, S/F-50””; archery season (Aug 25–29) was closed in 1993 and 1994.

^e Archery season August 10–17, S/F-50””, general open season Aug 20–Sep 20.

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
JUNEAU, AK 99802-5526

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 15B (1121 mi²)

GEOGRAPHIC DESCRIPTION: Kenai Peninsula

BACKGROUND

Historical records and reports from Kenai Peninsula residents indicate moose in Unit 15B have been relatively abundant throughout the century with the most recent peak in 1971. The near absence of wolves from 1913 to 1968 is believed to be one of the primary reasons for the growth of this population. A wildfire that burned approximately 500 mi² in Unit 15A in 1947 also benefited moose with improved winter range. A series of harsh winters from 1971 to 1974 subsequently reduced the moose population in Unit 15B, and the winters of 1998–99 and 1999–00 were severe. Population estimates show a decline in 1971 from 1975 moose to 843 moose by 1975. A census in February 1990 indicated a slight increase since 1975, placing the moose population at that time at 1042. A census conducted in February 2001 indicated between 777 and 1139 moose were in Subunit 15B. Predation effects are unchanged, and the current population is believed to be stable at about 1000 moose. Habitat conditions are declining with plant succession.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Central Kenai Peninsula

- Maintain a population of moose with a bull-to-cow ratio of 15:100
- Allow for maximum opportunity to participate in hunting in 15B West

In 15B East

- Maintain a population of moose with a bull-to-cow ratio of 40:100
- Provide for the opportunity to harvest a large antlered bull under aesthetically pleasing conditions

METHODS

We conduct aerial surveys in November and December of each year in selected trend count areas to determine the sex and age composition of the moose population in Subunit 15B.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

A February 2001 census of the 650.4 mi² of suitable moose habitat in Unit 15B revealed a population estimate of 958 moose, with a 95% confidence interval ranging from 777 to 1139 or $\pm 19\%$. The estimated mean density was 1.5 moose/mi². Because the census was conducted during February, after most bulls had shed their antlers, composition by sex was not determined. However, we completed age composition of the population, and calves comprised 20.6% of the population compared to 9.5% found in the February 1990 census following a severe winter.

This estimate indicates a slight decrease in population size, compared to 1042 animals estimated in 1990. Over the past 10 years, winters have been normal or mild with the exceptions of 1994–95, 1998–99 and 1999–00 when record snow depths were reported.

Population Composition

We collected insufficient data during this reporting period to determine sex and age composition for the entire unit. Aerial surveys were completed in the 4 count areas in 15B West in 1996, and we observed 224 moose (Table 1). Composition for this 15B West count was 39 calves and 33 bulls per 100 cows, and calves comprised 23% of moose observed (Table 1).

MORTALITY

Harvest

Season and Bag Limit.

	<u>Resident Open Season</u>	<u>Nonresident Open Season</u>
<i>Unit 15B</i> that portion bounded by a line running from the mouth of Shantatalik Cr. on Tustumena Lake, northward to the west fork of Funny R. to the Kenai Nat'l Wildlife Refuge; then east along the refuge boundary to its junction with the Kenai R. and Skilak Lake; then south along the western side of Skilak R., Skilak Glacier and Harding Icefield; then west	Sept 1–Sep 20 Sept 26–Oct 15	Sept 1–Sep 20 Sept 26–Oct 15

along the Unit 15B boundary
to the mouth of Shantatalik Cr.
One bull with 50-inch antlers by
drawing permit only; up to 100
permits will be issued.

Remainder of Unit 15B

One bull with spike-fork or 50-inch antlers

or antlers with 3 brow tines on at least one side,
by bow and arrow only or one bull with spike-fork
or 50-inch antlers or 3 brow tines or more on at
least one side

Aug. 10–Aug. 17

Aug. 20– Sept. 20

Board of Game Actions and Emergency Orders. Board of Game approved a proposal in spring 1999 to establish an archery-only season in 15B West.

Hunter Harvest. In Unit 15B West, 279 hunters went afield, harvesting 44 bull moose in 1999. In 2000, 273 hunters harvested 47 bull moose (Table 2 and 4). The mean harvest of 46 moose during this 2-year period represents a 12% decrease when compared to the mean harvest of 52 from 1992 to 1998.

Of the 44 moose reported by hunters in 1999, 33 (75%) of the harvest reports included antler spread data. Because the current bag limit is designed to focus harvest on yearling and mature bulls, we assumed an antler spread <35 inches met the yearling (spike-fork) requirement and antlers ≥ 35 inches wide were from mature bulls. The harvest comprised 23 (70%) spike-fork and 10 (30%) mature bulls. Successful hunters averaged 5.2 days afield compared to 8.5 for all hunters.

Forty-six (98%) of the 47 moose harvested in 2000 were reported with an antler spread. Thirty-two (70%) of these were yearlings and 14 (30%) were mature bulls. Nine (20%) of these bulls had an antler spread 50 inches or larger. Successful hunters averaged 7.4 days afield compared to 8.7 for all hunters.

Permit Hunts. Unit 15B East is managed as an area where hunters are able to view and harvest large antlered bulls. Hunters are allowed to harvest bulls with an antler spread of 50 inches or larger or bulls with antlers having 3 brow tines on at least 1 antler. It was also mandatory for successful hunters to present the antlers of their harvested bull for an official measurement by department staff. Hunters were selected by a random drawing with 100 permits issued for two separate seasons. A total of 1588 and 2017 applications were received during 1999 and 2000, respectively. Permittees reported harvesting 17 bull moose in 1999 and 17 in 2000 (Table 3). In 1999, 66 (66%) of the 100 permit holders hunted, yielding a success rate for hunters of 26%. In 2000, 62 (62%) of the permit holders hunted, resulting in a success rate for hunters of 27 percent. The mean antler spread from bulls harvested during 1999 was 52.8 inches with a range of 42.3 to

61.1 inches ($n = 14$). Seventy-nine percent (11 of 14) of these bulls had an antler spread of 50 inches or larger and 14% (2 of 14) were 60 inches or larger. The average antler of a bull harvested in 2000 was 54.1 inches with a range of 40.5 to 71.1. Seventy-six percent (13 of 17) of the bulls taken had an antler spread of 50 inches or larger and 18% (3 of 17) had a spread 60 inches or more. In 1999 and 2000, successful hunters averaged hunting 5.0 days and observed an average of 2 sublegal and 2 legal bulls per hunt. The highest number of bulls observed reported by one hunter was 27.

Hunter Residency and Success. Forty-three (98%) of the 44 successful Unit 15B West hunters in 1999 were unit residents, 1 (2%) was a non-unit resident and no nonresidents reported hunting (Table 4). Unsuccessful hunters comprised 204 (87%) unit residents, 31 (13%) non-unit residents, and no nonresidents. Hunter success was 16 % ($n = 44$).

In 2000, 43 (91%) of 47 successful hunters were unit residents and 4 (9%) were non-unit residents. 226 hunters reported as unsuccessful, with similar residency percentages as unsuccessful hunters in 1999. No nonresidents hunted in 15B West during 2000. Hunter success was 17% for 2000, ($n = 47$).

Transport Methods. In Unit 15B West, 66 and 74% of successful hunters reported highway vehicles as their primary means of transportation in 1999 and 2000, respectively (Table 5). The second most common transportation means was horses, at 11% in 1999, and 4-wheelers and ORVs at 7% in 2000. No successful hunters used aircraft in 1999 and only 2% in 2000. In Unit 15B East, over 90% of successful hunters used horses as their primary transport method to access their hunting area in each year.

Harvest Chronology. Twenty-five percent of the successful hunters harvested a moose during the archery season from Aug. 10–17 in 1999. In 2000, 17% of the harvest was taken during the same period. Thirty percent of the 1999 and 15% of the 2000 harvest occurred during the first 5 days of the general season (Table 6). In 1999, the next highest harvests (16%) occurred between September 11 to 15 and September 16 to 20. In 2000, the highest harvest (26%) occurred during the last 5 days of the season.

Other Mortality

The extent of weather-related mortality and predation by wolves and bears is unknown in Unit 15B. However, due to the moderately high density of black and brown bears and wolves, predation alone is believed to be controlling moose numbers at this time. Mortality from starvation was high in 1999–00 but minimal during 2000–01.

Forty-seven moose were reported killed in 15B West by vehicles from July 1, 1999 to June 30, 2000. In the same period for 2000–01, 30 moose were killed in vehicle/wildlife accidents. Moose killed by vehicles comprised 50% calves, 40% cows, and 10% bulls.

HABITAT

Assessment and Enhancement

The last large-acreage habitat enhancement occurred when a wildfire burned most of the unit in about 1890. No significant habitat enhancement, with the exception of the 1947 wildfire that burned 30,600 (8%) of the 398,000 acres below timberline, has occurred in this unit since 1890. The U.S. Fish and Wildlife Service enhanced approximately 3700 acres of predominantly winter habitat using a variety of mechanical tree removal techniques in 1968. Since 1968, 5 wildfires and 1 controlled burn have occurred, resulting in 11,500 acres burned, or 3% of the acres below timberline. Several small areas (less than 50 acres) have also been designated as wood cutting areas for noncommercial use. Judging from the relative density of moose in the wood cutting areas, I believe these small logged areas provide additional moose browse. However, by and large the quality of moose habitat in Unit 15B is relatively poor and declining due to natural plant succession.

CONCLUSIONS AND RECOMMENDATIONS

The reported harvest in Unit 15B West of 44 moose in 1999 and 47 in 2000 indicates a decreased harvest when compared with a mean of 52 moose harvested annually from 1992 to 1998. The mean annual harvest since the initiation of the selective harvest program in 1987 to 2000 was 49, ranging from 35 to 67. A mean of 72 bulls was harvested annually during the 5-year period (1982–86) before the selective harvest program began. A comparison of these mean harvests indicates a mean reduction of 32% in harvest during the first 14 years of the program. A similar comparison of hunting effort shows a decline from a mean of 389 hunters (range = 258–487) for the 5 years before selective harvest to a 14-year mean of 300 (range = 272–350) once the program began. A population modeling effort using estimated recruitment and mortality parameters predicted the harvest would approach the 72 moose mean harvest reported before the selective harvest program by 1991. The current level with no upward trend suggests this harvest objective will not be met. One possible explanation was moderate to severe winters resulting in high calf mortality during 1987–88, 1989–90, 1991–92, 1994–95, 1998–99 and 1999–00. The model prediction was based on normal winter mortality. Although winter mortality was not determined for these years, it was significant, reducing the number of bulls available for harvest. The decline in hunting effort also reduced harvest.

The permit hunt in 15B East continues to provide excellent hunting opportunities and is popular among resident hunters. The harvest of 17 bulls during 1999 and 17 in 2000 indicates a decline in harvest when compared with the mean harvest from the previous 5 years of 23 moose. This decline was the result of 2 factors: the loss of mature bulls during the severe winters and the increased price charged by outfitters to transport hunters into the area. Because only older bulls can be harvested in this area, the loss of bulls in these older age classes takes several years to replace. The only practical means of access into this area is by horse, but the cost of contracting with a local outfitter has increased beyond what most hunters are willing to pay. Although the number of hunters reported going afield has not declined, the number of hunters hunting in areas accessible by horse has declined. These remote areas have higher moose densities and provide a greater opportunity to harvest a moose.

Harvest levels are well within acceptable guidelines to maintain a minimum bull-to-cow ratio of 40 to 100. Since the objective for this area is to provide an opportunity to take a large bull and hunt under aesthetically pleasing conditions, I recommend no change in season. I would further recommend that the bag limit be maintained to preserve this area as a control area to evaluate changes in the male segment of the moose subpopulations in adjacent areas where both small and large bulls are harvested.

Summer and winter moose range on the Kenai National Wildlife Refuge in Unit 15B continues to deteriorate due to wilderness lands management policies that favor advanced forest succession. The department and U.S. Fish and Wildlife Service should cooperate on selected habitat enhancement projects (mechanical manipulation and prescribed burns) to improve moose habitat in the Slikok and Coal Lake areas.

Moose surveys have not been a high priority in 15B due to low harvest and the higher demand for moose in Subunits 15A and 15C. Since a complete survey has not been conducted since 1996, I recommend a survey be scheduled for fall 2002.

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Table 1. Unit 15B aerial moose composition counts and estimated population size, 1992–00

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	Moose observed	Moose/ hour	Estimated population size
1992–93 ^a	50	--	20	12	126	143	--	1042
1993–94 ^b								
1994–95 ^a	57	15	29	15	414	489	--	
1995–96 ^c								
1996–97	33	17	39	23	173	224	--	1052
1997–98 ^b								
1998–99 ^b								
1999–00 ^b								
2000–01 ^b								

^a Survey data from 15B East permit area only.

^b No surveys completed this year.

^c Late winter Gasaway Census completed (90% CI 733–1370). No composition data available.

Table 2. Unit 15B moose harvest^a and accidental death, 1992–00

Regulatory year	Hunter Harvest						Accidental death			
	Reported			Total	Estimated		Total			
	M(%)	F (%)	Unk.		Unreported	Illegal		Road	Other	Total
1992–93	47	0	1	48			20	42	--	42
1993–94	45	0	1	46			20	77	--	77
1994–95	56	0	0	56			20	59	--	59
1995–96	35	0	0	35			20	70	--	70
1996–97	55	0	1	56			20	80	--	80
1997–98	67	0	0	67			20	68	--	68
1998–99	57	0	0	57			20	74	--	74
1999–00	42	0	2	44			20	47	--	47
2000–01	47	0	0	47			20	30	--	30

^a Excludes permit hunt harvest.

Table 3. Unit 15B East moose harvest data by permit hunt, 1990–00

Hunt Nr/ Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk.	Total harvest
Totals for	1990–91	100	29	56	44	31(100)	0	0	31
all permit	1991–92	100	34	42	58	38(100)	0	0	38
hunts	1992–93	100	24	66	34	26(100)	0	0	26
DM530–DM539	1993–94	100	31	65	35	24(100)	0	0	24
	1994–95	100	34	68	32	21(100)	0	0	21
	1995–96	100	35	65	35	23(100)	0	0	23
	1996–97	100	31	61	39	27(100)	0	0	27
	1997–98	100	32	62	38	26(100)	0	0	26
	1998–99	100	37	70	30	19(100)	0	0	19
	1999–00	100	34	74	26	17(100)	0	0	17
	2000–01	100	38	73	27	17(100)	0	0	17

Table 4. Unit 15B West moose hunter^a residency and success, 1992–00

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Total	
1992–93	40	6	1	48 (15)	247	24	1	272	320
1993–94	39	6	1	46 (13)	269	32	1	304	350
1994–95	46	4	1	56 (17)	222	31	2	267	323
1995–96	34	0	1	35 (12)	215	26	8	249	284
1996–97	46	8	1	56 (17)	248	17	2	268	324
1997–98	59	7	1	67 (20)	253	14	3	270	337
1998–99	55	2	0	57 (17)	239	31	2	272	329
1999–00	43	1	0	44 (16)	204	31	0	235	279
2000–01	43	4	0	47 (17)	203	23	0	226	273

^a Excludes hunters in permit hunts.

^b Local = residents of Unit 15.

Table 5. Unit 15B West moose harvest^a percent by transport method, 1992–00

Regulatory year	Percent of harvest							Unknown	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle		
1992–93	4	6	2	8	0	2	67	10	48
1993–94	0	7	9	2	0	0	65	17	46
1994–95	2	11	4	2	0	0	66	16	56
1995–96	0	20	0	11	0	0	60	9	35
1996–97	0	13	5	4	0	2	66	11	56
1997–98	1	10	3	3	0	0	69	13	67
1998–99	0	5	5	9	0	5	65	11	57
1999–00	0	11	5	7	0	7	66	5	44
2000–01	2	6	9	4	0	0	74	4	47

^a Excludes permit hunt harvest.

Table 6. Unit 15B moose harvest^a chronology percent by harvest period, 1992–00

Regulatory Year	Harvest periods							Unknown	<i>n</i>
	8/10–17	8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20		
1992–93 ^b		--	--	48	13	19	17	4	48
1993–94 ^c		37	17	4	9	9	15	9	46
1994–95 ^c		30	5	5	9	4	39	7	56
1995–96 ^c		20	9	9	6	17	40	0	35
1996–97 ^c		33	2	11	15	13	19	7	56
1997–98 ^c		52	4	9	3	16	12	3	67
1998–99 ^c		42	9	4	11	12	16	7	57
1999–00 ^e	25	30	7	0	2	16	16	5	44
2000–01 ^e	17	15	4	0	13	19	26	6	47

^a Excludes permit hunt harvest.

^b General open season Sep 1–20, S/F-50”.

^c General open season Aug 20–Sep 20, S/F-50”.

^e Archery season August 10–17, S/F-50”, established in fall 1999.

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 15C (2441 mi²)

GEOGRAPHIC DESCRIPTION: Southern Kenai Peninsula

BACKGROUND

Moose are considered the region's most economically important wildlife species because of their popularity as a big game animal and their visible presence in developed areas. A rapid population decline occurred in the early 1970s after 3 severe winters in 4 years. The population increased during the 1980s in spite of high predator densities. In some areas the moose population has approached or exceeded carrying capacity.

Declining availability and quality of winter habitat are serious factors limiting moose on the lower Kenai Peninsula especially near Homer. During heavy snow accumulations, moose in Unit 15C are restricted to low elevation riparian habitats and south-facing benchlands. Some of the region's most important winter ranges include the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, the lower reaches of Fox River and Sheep Creek, and the Homer Bench. Community development in these areas is a threat to moose habitat.

Spruce bark beetles (*Dendroctonus rufipennis*) have established in many old-growth spruce stands in Unit 15. Nearly half a million acres of land on the Kenai Peninsula were infected with spruce bark beetles in 1995 (Peterson 1996) with over 2 million acres infested to date. Nearly all Kenai forest lands have been affected to date. Salvage logging (harvest of dead and infested stands of trees) is ongoing throughout the Kenai (Steve Albert ADF&G pers. commun.). Reduction of old-growth forests may be beneficial to the moose population by enhancing nutritional quality and availability of winter food plants. However, site preparation is crucial to successful moose habitat enhancement.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

- Maintain a population of 3000 moose.
- Maintain a minimum posthunting sex ratio of 15 bulls:100 cows.

METHODS

All harvest data is collected and reported through the statewide harvest reporting system. Information is collected from hunters on area hunted, transportation used, amount of time spent afield and, if successful, size of the moose harvested.

We documented winter moose mortalities by reports from the public and coincident with ADF&G field activities. Whenever practical, we inspected carcasses to determine their location, sex, age class, and approximate time and cause of death. Leg bones were collected to examine bone marrow for fat content.

Standard late fall composition surveys are completed in trend count areas. We completed aerial sex and age composition surveys in late November under favorable snow conditions. All information was entered in the Wildlife Information Database (WIDB) software until 1999 when this software no longer functioned. After 1999, the survey data was maintained in a local database.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Results from aerial surveys and harvest reports indicate the moose population has remained relatively stable since the mid 1980s. Both the 1997–98 and the 1998–99 winters were considered severe in most of the region with deep and persistent snow. Documented winter mortality was predominantly calves of the year; however, we suspect that some adults were also lost. Winter severity was reflected by the lower-than-average hunter harvest in subsequent years. We believe the moose population declined slightly during this reporting period and may be at the lower end of the estimated 2500–3000 animals.

Population Size

A complete Gasaway-style (1986) census was conducted during late winter of 1992 under optimal snow conditions. The lowland portion of Unit 15C (1190 mi²) was censused, and a population estimate of 2079 moose was calculated from survey results. Confidence intervals around the estimated population ranged from $\pm 19.81\%$ for 80% CI (1677–2491) to $\pm 31.48\%$ for 95% CI (1425–2734). Low sightability of moose caused the high CI. The true population for the census area was probably near the upper confidence limits. We estimated an additional 200–300 moose in the mountainous portion of Unit 15C outside the census area.

Population Composition

A standard composition survey was completed in one trend area in Unit 15C during 1999 and one late winter survey in 2000. We classified 578 moose in 1999 with ratios of 18 calves:100 cows and 27 bulls:100 cows. Calf percentage was 12%, reflecting poor neonatal survival in this unit where predation is normally high (Table 1). In the 2000 winter survey we counted 329 moose with 22% calves indicating much better calf survival.

MORTALITY

Harvest

Season and Bag Limit. In 1993 the moose season was extended from the 1 September–20 September season to 20 August–20 September. The bag limit is 1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least 1 side. The 5-year average harvest for 15C was 272 moose (Table 2).

Board of Game Action and Emergency Orders. The Board of Game has considered proposals to change or eliminate the Lower Kenai Controlled Use Area during most of its region II meetings. In 1994 the board allowed a 2-day “window” during the last 10 days of the general season for hunters to use motorized vehicles. Subsequent proposals to further change or eliminate the CUA have failed.

A limited entry antlerless moose season was first proposed in 1993. The local advisory committee failed to support this hunt; therefore, the board did not consider the proposal without committee support. A modified version of this proposal was again proposed to the board in 1995 with the support of the local advisory committees. The board passed this proposal, however, hunters were restricted to taking cows without calves and had to be accompanied by department personnel. With input from the Advisory committees, the board has reauthorized the antlerless hunts each year with moderate changes. Currently the drawing season runs concurrently with the general season and the number of permits increased to 50 for 2002.

Hunter Harvest. In 1999, 1163 hunters harvested 171 moose during the general season (Table 4). One hundred four (61%) hunters reported taking spike/fork bulls (<35 inches) compared to 63 (37%) hunters who harvested bulls with an antler spread of at least 50 inches or having 3 brow tines on at least 1 antler. Four (2%) indicated either unknown size or illegal classification.

In 2000, 1146 hunters harvested 208 moose during the general season (Table 4). One hundred nineteen hunters (57%) reported taking spike-fork bulls compared to 78 hunters (38%) who harvested bulls with antler spreads of at least 50 inches or with 3 brow tines on at least 1 antler. Twelve reports (6%) indicated either unknown size or illegal classification.

Permit Hunts. There was a Tier II subsistence season 1–30 September in a portion of Unit 15C southwest of a line from Point Pogibshi to the point of land between Rocky and Windy Bay. The bag limit was 1 bull. Since 1992 an average of 1 moose has been taken annually, however no moose were taken in either 1999 or 2000 (Table 3).

Beginning in 1995, the Board of Game authorized limited drawing permit hunts for antlerless moose near Homer. In 1999 thirty-five permits were issued and hunters harvested 7 moose (27% success) (Table 3). No permits were issued in 2000 since survey results indicated the moose population was near objectives and winter severity index was high. The remainder of the Unit 15C moose season was 20 August–20 September for 1 bull with spike-fork or 50-inch antlers.

Hunter Residency and Success. Hunter success in 1999 was 15%, which was the lowest success rate reported in the last 9 years. One hundred forty five (85%) successful hunters were Unit 15 residents, 14 (8%) were nonunit residents, and 10 (6%) were nonresidents (Table 4). Residency

reported for unsuccessful hunters was 875 unit residents (88%), 109 nonunit residents (11%), and 8 nonresidents (1%).

Hunter success in 2000 was 18%. One hundred seventy eight (86%) successful hunters were unit residents, 25 (12%) were nonunit residents, and 5 (2%) were nonresidents (Table 4). Residency reported for unsuccessful hunters was 836 (89%) unit residents, 107 (11%) nonunit residents, and 24 (3%) nonresidents.

Harvest Chronology. Reported chronology of harvest reveals the highest percentage of moose harvested occurred during the first 6 days of the season in all years. When the season began 20 August, this trend did not change (Table 5).

Transport Methods. In 1999 off-highway vehicles (OHVs consisting of ORVs and 3 and 4-wheelers) and highway vehicles were reported as the primary means (46% and 40% respectively) of transportation used by successful hunters (Table 6). Horses (8%), boats (2%) or aircraft (1%), were the least common transport modes.

In 2000, 52% of successful hunters reported highway vehicles as their means of transportation (Table 6). The number of hunters using OHVs increased in both years and exceeded 50% for the first time. Hunters routinely use the extensive network of trails and logging roads for hunting. The second most common transportation mode for successful hunters was highway vehicles (26%). Hunters using horses (13%), boats (4%), or aircraft (<1%) were least common.

Other Mortality

In addition to reported harvest, at least 59 moose were killed in Unit 15C by motor vehicles during 1999. At least 58 moose were killed in 2000 by motor vehicles (Table 2). Approximately 75% of these animals were salvaged for human use. The "Give Moose A Brake" program (Del Frate and Spraker 1991) continued its awareness activities throughout the peninsula. Crippling loss by hunters is unknown but is believed to be less than 10% of the reported harvest.

The moose population that winters on the Homer Bench continues to be at or above carrying capacity. Additional winter mortality is expected under normal or poor winter conditions.

HABITAT

Assessment

Reduction of some old-growth forest in response to spruce bark beetle infestations through logging has been underway in Unit 15C for over 10 years. We recommended logging prescriptions and reforestation techniques that encourage hardwood production. If hardwood production increases in these affected areas, moose will probably benefit from higher-quality early seral stage habitat. However, if site preparation is not adequate, grass (*Calamagrostis* spp.) will compete with hardwood and spruce seedlings, creating less desirable moose habitat.

Enhancement

As part of licensing requirements, the Alaska Energy Authority (AEA) produced a mitigation plan to maintain or improve habitat within the Bradley Lake hydroelectric area. Moose were

significantly affected through project construction and operation. Mitigation focused on compensation for habitat lost from the rising lake. A total of 593 acres of land in the Fritz Creek drainage near Homer was purchased and a \$150,000 trust fund was established to provide money for moose management. Trustees were selected (1 each) from ADF&G, AEA, and the Homer Fish and Game Advisory Committee. Trustees continue to struggle to maximize the trust to benefit moose on the lower peninsula. Future land acquisitions of quality moose habitat are being considered.

CONCLUSIONS AND RECOMMENDATIONS

Both the 1997–98 and 1998–99 winters were considered severe with high documented mortality. We suspect that the moose population may have declined during this period. The 1999–2000 winter was variable with deep snow in the northern portions of the subunit that further affected moose survival. The lower than average harvest for both the reporting years reflected this trend. The 2000–2001 winter was milder than average and the population has begun to recover. Human-caused moose mortality, including road kills and harvest, represented 10–12% of the estimated moose population of 2500.

We identified 2 solutions to address the problems of declining habitat quality and starvation of moose in the Homer area. Habitat enhancement and population reduction within the affected areas would achieve these results. We believe both should occur simultaneously. Approximately \$210,000 remains in a moose-mitigation trust that has been set aside for use in the Homer area. We recommend a portion of this money be allocated to habitat enhancement as soon as possible.

We also began population reduction efforts. In 1995 the Board of Game authorized a moose hunt with support from the local Advisory Committee. The goal of this program was to reduce the wintering moose population in the Homer area to allow browse to regenerate. We recommend that the program continue and the wintering population maintained at approximately 360 animals.

The harvest of moose and hunter success under spike-fork/50-inch regulations fluctuated in response to previous winter severity. Spike-forks are almost always yearlings, and the proportion of young animals in the harvest provides a "barometer" of the health of that particular cohort. By properly evaluating severity of a particular winter, we can also forecast the upcoming harvest.

Impact of predation by wolves and bears is unknown. The unit supports an estimated 50–70 wolves in 5 to 8 packs, a ratio of at least 1 wolf:35 moose and no more than 1 wolf:50 moose. Bears exert additional pressure on Unit 15 moose. Black bear are abundant throughout the unit, and brown bear are common and may be increasing in all drainages supporting salmon. Predation should prevent the moose population from increasing, except in years with mild winters.

The bull-to-cow ratio has been higher than the recommended minimum objective of 15 bulls per 100 cows since the selective harvest program began. However the survey areas may not accurately reflect the ratio across the unit. Bull-to-cow ratios during fall composition surveys varied, depending on the units surveyed and if animals were still in post rut aggregations.

Adequate bull-to-cow ratios are desired to minimize the length of the rut and ensure that most cows conceive during their first estrous cycle (Schwartz et al. 1994)

Hunter numbers peaked during the mid-to-late 1990s then declined during this reporting period. Some hunters have complained of overcrowded hunting conditions, however the high use of OHVs distributed hunters across the unit. Trail damage reports are becoming more prevalent and some action may be necessary in the future to reduce habitat degradation. To avoid shifts in hunting pressure, Unit 15C season length or bag limit should not be altered until similar changes are recommended for the remainder of Units 15 and 7.

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Table 1. Unit 15C fall aerial moose composition counts and estimated population size, 1992–2000.

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	Total Moose observed	Moose /hour	Estimated Population size
1992–93	28	10	33	21	663	834	62	2500
1993–94 ^a								
1994–95	19	7	41	26	1,283	1,727	91	2500
1995–96 ^a								
1996–97	29	11	37	22	285	343	73	2500
1997–98	31	13	46	26	649	877	60	2500
1998–99 ^b	61	6	31	16	87	104	37	2300
1999–2000	27	7	18	12	506	578	103	2500
2000–2001 ^c				22	256	329	40	2500

^a No surveys conducted.

^b Partial survey.

^c Late winter survey.

Table 2. Unit 15C moose harvest^a and accidental death, 1992–2000.

Regulatory year	Hunter Harvest										Total
	Reported				Estimated			Accidental death			
	M	F	Unk.	Total	Unreported	Illegal	Total	Road	Train	Total	
1992–93	185	0	0	185			30	45	--	45	260
1993–94	270	0	0	270			30	75	--	75	375
1994–95	307	0	0	307			30	53	--	53	390
1995–96	192	0	0	192			30	63	--	63	285
1996–97	347	0	0	347			30	44	--	44	421
1997–98	351	0	0	351			30	84	--	84	465
1998–99	283	0	0	283			30	76	--	76	389
1999–2000	171	0	0	171			30	59	--	59	260
2000–2001	208	0	0	208			30	58	--	58	296

^aExcludes permit hunt harvest.

Table 3. Unit 15C moose harvest data by permit hunt, 1992–2000.

Hunt Nr. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk	Total harvest
TM549 Point Pogibshi	1992–93	8	12	50	38	3	0	0	3
	1993–94	5	0	80	20	1	0	0	1
	1994–95	5	20	75	25	1	0	0	1
	1995–96	4	0	75	25	1	0	0	1
	1996–97	4	25	66	33	1	0	0	1
	1997–98	4	25	100	0	0	0	0	0
	1998–99	4	0	50	50	2	0	0	2
	1999–2000	4	25	100	0	0	0	0	0
	2000–2001	4	0	100	0	0	0	0	0
DM541– DM548 ^b	1995–96	30	10	41	59	0	16	0	16
DM549	1996–97	20	15	47	53	0	9	0	9
	1997–98	20	20	69	31	0	5	0	5
	1998–99	20	30	79	21	0	3	0	3
	1999–2000	35	20	73	27	0	7	0	7
	2000–2001	0							0
DM550	1996–97	20	15	24	76	0	13	0	13
	1997–98	20	10	11	89	0	16	0	16
	1998–99	30	20	66	33	0	8	0	8

^a Tier II moose hunt for 1 bull.

^b DM541-DM548 was renamed to DM549–DM550 for 1996 through 1998 and again renamed to DM549 for 1999.

Table 4. Unit 15C moose hunter^a residency and success, 1992–2000.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Total ^c (%)	Local ^b resident	Nonlocal resident	Nonresident	Total ^c (%)	
1992–93	163	13	7	185 (16)	850	127	7	988 (84)	1171
1993–94	230	28	6	270 (21)	854	159	8	1044 (79)	1314
1994–95	252	31	9	307 (22)	910	143	21	1120 (78)	1427
1995–96	171	17	4	192 (20)	696	77	4	781 (80)	973
1996–97	303	33	11	347 (24)	993	100	12	1112 (76)	1459
1997–98	316	26	9	351 (25)	914	106	16	1041 (75)	1392
1998–99	256	24	2	283 (22)	903	110	15	1032 (78)	1315
1999–2000	145	14	10	171 (15)	875	109	8	995 (85)	1163
2000–2001	178	25	5	208 (18)	836	107	24	943 (82)	1146

^a Excludes hunters in permit hunts.

^b Local = residents of Unit 15.

^c Total columns include hunters that did not specify residency.

Table 5. Unit 15C moose harvest^a chronology percent by harvest periods, 1992–2000.

Regulatory year	Harvest periods						Unknown	<i>n</i>
	8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20		
1992–93 ^b	--	--	43	18	14	21	4	185
1993–94 ^c	29	12	14	17	9	14	4	270
1994–95 ^c	34	11	16	10	11	13	4	307
1995–96 ^c	26	10	10	13	14	21	6	192
1996–97 ^c	33	12	11	14	9	14	4	347
1997–98 ^c	32	12	8	12	13	17	7	351
1998–99 ^c	31	11	12	13	12	17	5	283
1999–2000 ^c	28	11	11	18	12	16	5	171
2000–2001 ^c	28	13	18	12	10	16	4	208

^a Excludes permit hunt harvest.

^b General open season Sep 1–Sep 20.

^c General open season Aug 20–Sep 20.

Table 6. Unit 15C moose harvest^a percent by transport method, 1992–2000.

Regulatory year	Percent of harvest							Unknown	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle		
1992–93	4	17	3	24	0	14	31	7	185
1993–94	3	12	3	35	0	12	30	5	270
1994–95	2	9	5	35	0	7	38	5	307
1995–96	4	7	5	33	0	7	40	4	192
1996–97	3	7	4	37	0	8	39	2	347
1997–98 ^b	1	7	3	36	0	6	42	5	351
1998–99	1	6	2	35	0	6	44	5	283
1999–2000	1	8	2	39	0	7	40	4	171
2000–2001	<1	13	4	45	0	7	26	4	208

^a Excludes permit hunt harvest.

^b One hunter reported using an airboat to harvest a moose.

MOOSE MANAGEMENT REPORT

From: 1 July 1999

To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 16A (1850 mi²)

GEOGRAPHIC DESCRIPTION: West side Susitna River (Kahiltna River to Chulitna River)

BACKGROUND

The moose population in Unit 16A has been known to fluctuate greatly due to severe winters. Griese (1996) described significant winter die-offs of moose occurring at least once each decade beginning with the 1950s. The winter of 1989–90 caused 30–40% mortality from malnutrition, highway accidents, and predation facilitated by deep snows. Recovery from the resulting low density was slowed by subsequent deep-snow winters of 1990–91, 1992–93 and 1994–95 and by increasing predator populations.

Unit 16A shares land within Denali National Park and Denali State Park, and has relatively few access points from the road system. After 16A was separated from Unit 16B in 1973, historical annual hunter harvest fluctuated as a result of variable moose densities, bag limits, and improved hunter access (Griese 1996). Harvest numbers ranged between 308 (1984) and 37 (1990). The annual harvest has averaged 166 bulls in the past 5 seasons (1996-2001).

Starting in 1993, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least 1 side or a minimum of 3 brow tines on at least 1 side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork-50-inch” (SF50) (Schwartz et al 1992).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Produce moderate, sustainable levels of moose for humans, while allowing sustainable harvest levels of predators to meet desirable predator:prey ratios
- Enhance wildlife viewing opportunities within state and national parks

MANAGEMENT OBJECTIVES

- Maintain a posthunt population of 3500–4000 moose, with a sex ratio of 20–25 bulls:100 cows during the rut
- Achieve an annual harvest of 190–360 moose

METHODS

On November 17–25, 2000 we conducted a stratified-random-sample survey in Unit 16A (Becker and Reed 1990). We generated a population estimate and age/sex statistics using MOOSEPOP (Becker and Reed 1990). We attempted to categorize antler size of bulls and identify brow-tine counts on bulls with 30-inch or greater antlers. The previous survey in this unit was conducted in the fall of 1997.

We monitored the harvest of moose from harvest and permit reports. Bulls taken by permittees were required to provide antlers for measurement and lower front teeth for age determination. We measured antler width, number of points per brow palm, and number of points per main palm on each side. The Department of Public Safety provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The population decreased about 33% between the fall surveys in 1997 (3636 ± 614 : 80% CI) and 2000 (2420 ± 528 : 80% CI) (Table 1).

Population Composition

The composition assessed in 2000 included 28 bulls and 22 calves:100 cows which is down from 33 bulls and 35 calves:100 cows found in 1997 (Table 1).

MORTALITY

Harvest

Season and Bag Limit. The general open season in 1999 and 2000 was 20 August–25 September and 5–15 December for all resident and nonresident hunters. During the early season the bag limit was 1 bull under SF50 antler restrictions. The late season bag limit was 1 bull with spike or fork antlers only. We issued 100 any-bull permits for 1–15 November (DM556).

Board of Game Actions and Emergency Orders. During the spring 2001 Board of Game meeting the winter spike-fork-only hunt was eliminated and the any-bull permits were discontinued. To make up for these lost hunting opportunities yet decrease the harvest potential found with the discontinued hunts, the Board agreed to extend the general season 5 days to end on September 30th and add an August 10–17 archery-only season.

Hunter Harvest. The average annual harvest between 1999–2001 was 154, which was below the previous 3-year average of 189 and below the harvest objective minimum (190-360) (Table 2). The decrease in harvest is likely due to lower moose densities but also influenced by the removal of the any-bull permits (Table 3) and spike-fork-only winter hunt in 2001.

Hunter Residency and Success. The number of moose hunters in Unit 16A averaged 892 during 1999–2001 (Table 4). The majority of hunters are not residents of Unit 16 (Table 4). Combined hunter success was 16% during 1999–2001, down from 18% in the previous 3-year period (Table 4).

Harvest Chronology. Hunters took advantage of the additional 21–25 September period and during that period killed more moose than any other 5-day period in 2001 (Table 5). No moose were taken in the August 10-17 archery season in 2001. The pattern of harvest chronology was generally similar to past years.

Transport Methods. Transport methods were similar to past years (Table 6). With the removal of the late spike-fork season and November drawing hunts, snowmachines were not used in the 2001 season (Table 6).

HABITAT

Enhancement

An 18,000-acre area east of the lower end of Kroto Creek (Deshka River) has been prepared for a controlled burn since 1994 (W. Collins pers. comm.). The prescribed burn continues to be delayed because of concern for public criticism in the wake of the 1995 Miller's Reach/Big Lake wildfire. In addition, ideal conditions for such a burn have not coincided with fire crew presence.

CONCLUSIONS AND RECOMMENDATIONS

The approximate 33% decline in the moose population between the 1997 and 2000 surveys is likely due to the severe winter conditions in 1999-00 and an increase in wolf numbers (Masteller 2000). The harvest increased slightly in 2001 due to an extension of the general season (Table 4). Hunter effort will likely continue to increase in Unit 16A and surrounding units due to the closure of the general season in Unit 16B. It is unlikely that the moose population will reach the objective levels until the predator population decreases and we have milder winters with moderate snow-depths.

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Table 1 Unit 16A fall aerial moose composition counts and estimated subpopulation sizes, 1990–2001

Regulatory year	Bull: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Percent calves	Adults observed	Total moose observed	Moose /mi ²	Population estimate
1990–91 ^a	27	7	31	29	1105	1366	1.8	3123±289 ^b
1991–92 ^c	--	--	--	--	--	--	--	--
1992–93 ^d	36	11	32	19	779	963	1.7	2900 ± 564 ^b
1993–94 ^d	24	10	24	16	698	828	1.9	3284 ± 903 ^b
1994–95 ^e	36	11	33	19	804	981	--	3000–3,600
1995–96 ^c	--	--	--	--	--	--	--	--
1996–97 ^c	--	--	--	--	--	--	--	--
1997–98 ^d	33	12	35	21	974	1234	2.1	3636 ± 614 ^b
1998–99 ^c	--	--	--	--	--	--	--	--
1999–00 ^c	--	--	--	--	--	--	--	--
2000–01 ^d	28	6	22	15	661	787	1.4	2420 ± 528
2001–02 ^c	--	--	--	--	--	--	--	--

^a Gasaway et. al. (1986) survey methodology

^b 80% C.I.

^c No surveys conducted

^d Becker and Reed (1990) survey methodology

^e Sex and age composition surveys

Table 2 Unit 16A annual moose harvest and accidental death, 1990–2001

Regulatory year	Reported			Estimated			Accidental ^d			Grand
	M	F	Total ^a	Unreported ^b	Illegal ^c	Total	Road	Other	Total	Total
1990–91	37	0	37	2	10	12	6	0	6	55
1991–92	135	0	138	7	15	22	15	0	15	175
1992–93	136	0	138	7	15	22	9	0	9	169
1993–94	96	0	98	10	20	30	9	0	9	137
1994–95	115	0	115	10	20	30	4	0	4	149
1995–96	134	0	134	8	25	33	15	0	15	182
1996–97	197	1	199	14	25	39	4	0	4	242
1997–98	198	0	198	14	25	39	14	0	14	251
1998–99	169	1	169	12	25	37	10	0	10	216
1999–00	168	0	171	12	25	37	16	0	16	224
2000–01	141	0	141	10	25	35	20	0	20	196
2001–02	150	0	150	11	25	36	15	0	15	201

^a Includes moose of unknown sex

^b Derived by taking 5–10% of the reported kill

^c Includes moose taken in defense of life or property

^d Roadkill is minimum number

Table 3 Unit 16A moose harvest data by permit hunt, 1990–2001

Hunt No.	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest		
							Bulls	Cows	Total
DM554 and DM556 (1–15 Nov.)	1993–94	1310	100	20	64	36	28	0	28
	1994–95	1715	100	12	51	49	49	0	49
	1995–96 ^a	1349	100	17	53	30	30	0	30
	1996–97 ^a	1188	100	17	39	44	44	0	44
	1997–98 ^a	1192	99	11	48	41	40	0	40
	1998–99 ^a	1489	100	17	58	24	24	0	24
	1999–00 ^a	3068	100	11	59	30	29	0	29
	2000–01 ^a	3513	100	15	64	21	21	0	21
	2001–02 ^b	--	0	--	--	--	--	--	--
DM552 (20 Aug.–20 Sept)	1995–96	711	100	22	53	25	25	0	25
	1996–97	774	100	15	65	20	19	0	19
	1997–98	652	99	10	72	18	16	0	17
	1998–99	965	100	13	63	25	24	0	24
	1999–00 ^b	--	0	--	--	--	--	--	--
	2000–01 ^b	--	0	--	--	--	--	--	--
	2001–02 ^b	--	0	--	--	--	--	--	--

^a DM556 only^b Discontinued hunt

Table 4 Unit 16A moose hunter residency and success, 1990–2001

Regulatory year	Successful						Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Non- resident	Unk	Total	(%)	Local ^a resident	Nonlocal resident	Non- resident	Unk	Total	
1990–91	4	35	1	1	37	(7)	23	448	9	16	473	510
1991–92	9	123	4	2	138	(16)	28	673	12	8	721	859
1992–93	7	126	4	1	138	(16)	34	630	24	21	709	847
1993–94	5	62	1	2	70	(11)	37	529	6	13	548	618
1994–95	6	57	2	1	66	(12)	32	488	8	4	500	566
1995–96	7	65	6	1	79	(12)	62	516	16	6	600	679
1996–97	14	116	4	3	136	(19)	53	513	12	8	586	725
1997–98	16	113	11	1	141	(18)	54	598	25	3	626	767
1998–99	5	112	2	2	121	(16)	56	572	19	7	654	775
1999–00	14	115	9	4	142	(17)	41	643	18	10	715	857
2000–01	2	109	6	3	120	(12)	55	772	22	5	854	974
2001–02	12	128	10	0	150	(18)	39	632	19	5	695	845

^a Unit 16 residents

Table 5 Unit 16A moose harvest chronology^a by months of season, 1990–2001

Year	<u>August</u>			<u>September</u>			<u>November</u>		<u>December</u>		Unknown	Total
	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15		
1990–91 ^b	--	--	21	11	--	--	--	--	--	--	5	37
1991–92 ^c	--	--	72	53	7	--	--	--	--	--	6	138
1992–93 ^c	--	--	75	51	6	--	--	--	--	--	5	138
1993–94 ^d	13	4	8	19	24	--	--	--	--	--	2	70
1994–95 ^d	6	4	11	13	29	--	--	--	--	--	1	64
1995–96 ^e	8	1	11	12	35	--	--	5	1	4	2	79
1996–97 ^e	5	5	19	25	41	--	--	18	6	10	7	136
1997–98 ^e	20	7	11	29	36	--	--	17	4	8	9	141
1998–99 ^e	9	5	13	22	41	--	--	11	4	13	3	121
1999–00 ^f	7	8	15	21	38	32	--	--	2	15	3	142
2000–01 ^f	6	3	5	16	36	29	--	--	7	11	7	120
2001–02 ^g	8	3	7	8	34	36	52	--	--	--	2	150

^a Does not include harvest from drawing permit hunts

^b Open season = Sep 1–10

^c Open season = Sep 1–15

^d Open season = Aug 20–Sep 20 (SF-50)

^e Open season = Aug 20–Sep 20 (SF-50), Nov 20–Dec 15 (SF-only)

^f Open season = Aug 20–Sep 25 (SF-50), Dec 1–15 (SF-only)

^g Open season = Aug 10–17 (Archery-only), Aug 20–Sep 30 (SF-50)

Table 6 Transport method used by successful moose hunters^a in Unit 16A, 1990–2001

Regulatory year	Percent of successful moose hunters							Nr. moose harvested	
	Airplane	Horse	Boat	3- or 4- Wheeler	Snowmachine	ORV	Highway vehicle		Unk
1990–91	22	3	24	14	0	24	14	0	37
1991–92	15	0	25	30	0	11	17	1	138
1992–93	16	0	21	28	0	14	18	3	138
1993–94	13	0	23	34	0	11	19	0	70
1994–95	21	0	17	33	0	8	20	1	64
1995–96	7	0	16	24	7	12	32	1	79
1996–97	9	0	19	30	17	6	15	4	136
1997–98	9	0	16	34	16	6	15	4	141
1998–99	10	1	21	21	16	7	22	2	121
1999–00	8	1	26	39	6	3	16	2	142
2000–01	10	0	20	40	6	13	12	0	120
2001–02	10	0	27	37	0	8	17	1	150

^a Does not include harvest from drawing permit hunts

MOOSE MANAGEMENT REPORT

From: 1 July 1999

To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 16B (10,405 mi²)

GEOGRAPHIC DESCRIPTION: West Side of Cook Inlet and Kalgin Island

BACKGROUND

Moose numbers almost certainly exceeded 10,000 in Unit 16B during the early 1980s (Griese 1996). Harkness (1993) speculated the population before the severe winter of 1989–90 was probably 8500–9500 moose. Following a 15–20% decline after the winter of 1989–90, moose numbers in the unit continued to decline in response to continued deep snow winters and growing predator influence (Griese 2000). Faro (1989) implied that predation on neonatal moose calves by bears influenced recruitment and caused the current declining trend. McDonough (unpublished data) estimated 150–200 wolves in the unit during the winter of 2001–02, up dramatically from the 120–140 wolves estimated in the fall 1998 (Masteller 2000).

Since 1972, when Unit 16B was separated from 16A, hunter harvest of moose has declined from a high of 842 in 1973 to only 99 moose during a short 1990 season. Harvest in the 1990s averaged 249 moose per year. From 1962–74, hunting seasons in Unit 16B were liberal (August 20–September 30 and November 1–30 seasons for either-sex moose). Through 1989, except 1975, an antlerless moose hunt was held during September. Increasing numbers of hunters and lower moose recruitment caused late season hunts to be converted to permit hunts beginning in 1983. Tier II permits were issued starting in 1990 to assure local residents an opportunity to meet subsistence needs.

Starting in 1993, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least 1 side or a minimum of 3 brow tines on at least 1 side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork-50-inch” (SF50) (Schwartz et al 1992).

The Kalgin Island moose population resulted from a translocation of calves during 1957–59. Numbers grew to a peak density of 7 moose/mi² during 1981 (Taylor 1983) but was reduced to 1 moose/mi² by 1985. High moose densities severely degraded habitat and caused the adoption of restrictive population objectives that maintained moose densities at less than 1 moose/mi² while vegetation recovered (Faro 1990). There has been an any-moose registration hunt since 1999.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Produce high yields of moose for humans and provide maximum opportunity to hunt moose

POPULATION OBJECTIVES

Unit 16B (excluding Kalgin Island)

- Maintain a moose population of 6500–7500 moose and 20–25 bulls:100 cows

Kalgin Island

- Maintain a posthunt population of 20–40 moose and at least 15 bulls:100 cows

HUMAN USE OBJECTIVES

- Achieve a harvest of 310–600 moose

METHODS

Because of the Unit's size, we divide 16B into 3 zones (north, middle, and south) for survey purposes. In November 1999, we conducted a Gasaway et al. (1986) survey in 16B-middle (north of the Beluga River/Lake and south of Skwentna River). We conducted Becker surveys (Becker and Reed 1990) in 16B-middle in November 2001, and in 16B-North (North of Skwentna River) in November 2000 and 2001. Composition counts were conducted in large survey units in 16B-south (south of Beluga River) in December 2000, and October 2001.

We generated a population estimate and age/sex statistics using MOOSEPOP (Becker and Reed 1990). We attempted to categorize antler size of bulls and tally brow-tines on bulls with 30-inch or greater antlers.

Surveys were conducted on Kalgin Island in January and December 2000, and October 2001.

We collected harvest and hunter effort data from registration (Kalgin), harvest and Tier II permit reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population size

We estimated the 16B-middle population at 3314 ± 489 (80% C.I.) in fall 1999 and 1836 ± 267 (80% C.I.) in fall 2001 (Table 1). We estimated the 16B-north population at 909 ± 184 (80% C.I.) in fall 2000 and 1187 ± 182 (80% C.I.) in fall 2001 (Table 1). The Unit 16B fall population in 2001 is likely between 3700–4000 moose. The latest survey on Kalgin Island conducted after the hunt in 2001 showed 125–150 moose.

Population Composition

The 16B-middle composition assessed in 1999 included 28 bulls and 9 calves:100 cows, and 32 bulls and 10 calves:100 cows in 2001 (Table 1). The 16B-north composition assessed in 2000 included 39 bulls and 7 calves:100 cows, and 40 bulls and 14 calves:100 cows in 2001 (Table 1). The 16B-south composition assessed in 1999 included 38 bulls and 8 calves:100 cows, and 31 bulls and 13 calves:100 cows in 2001 (Table 1). Overall, the composition in the entire unit in 2001 was 33 bulls and 12 calves:100 cows. Kalgin Island in 2001 had 60 bulls and 80 calves:100 cows.

MORTALITY

Harvest

Season and Bag Limit.

During 1999–00 and 2000–01, in the area south and west of Beluga River, Beluga Lake, and Triumvirate Glacier, the season was 20 August–30 September for residents only with a bag limit of 1 bull with SF50 antlers. In the remaining northern 2/3 of the unit, the same season and bag limit were open to both residents and nonresidents. In addition, 260 permits were issued for a Tier II hunt during 15 November–28 February for any bull. These Tier II hunt areas are divided into 3 units (TM565, TM567, TM569).

The general season was closed in 2001. Four hundred Tier II permits were issued for 20 August–30 September (SF-50) and the 15 November–28 February (any bull) periods.

The registration hunt for any moose on Kalgin Island was 20 August–30 September in 1999 and shortened to 20 September in 2000 and 2001.

Board of Game Actions and Emergency Orders. At the March 2001 meeting, the Board eliminated the general season in 16B because of the continuing decline in moose numbers unitwide. Responding to local advisory committee's recommendations, the Board increased the population objective to 6500–7500 from 5500–6500. The Board also shortened the hunt on Kalgin Island by 10 days.

Hunter Harvest. The harvest decreased dramatically in 2001 due to the closure of the general season (Table 2). The Tier II harvest increased in proportion to the greater allotment of permits issued in 2001 (Table 3). The harvest on Kalgin Island has decreased each year since the 1999 registration season started (Table 3).

Hunter Residency and Success. General season hunter success decreased slightly in 1999 and 2000 (Table 4).

Harvest Chronology. Harvest chronology in the general harvest has not changed significantly in the past 6 seasons (Table 5).

Transport Methods. The lack of road accessibility to the unit is reflected by the dominance of aircraft and boat transportation used by successful hunters. Transport methods in the general harvest have not changed significantly in the past 10 seasons (Table 6).

Other Mortality

The severe winter of 1999–00 negatively impacted the moose population. In midwinter we observed moose floundering in snow depths exceeding 5 feet (Griese 2000). As the winter progressed, rain fell giving the surface an ice crust that facilitated easy wolf travel and complicating moose movement. Recent survey results reflect a major population decline. The effects of predation by wolves and bears continue to be apparent on mainland 16B as assessed from low calf recruitment in the fall. A wolf survey conducted in January/February 2002, estimated the minimum number of wolves in Unit 16B at 150–200, up dramatically from the 120–140 wolves estimated in the fall 1998 (Masteller 2000).

CONCLUSIONS AND RECOMMENDATIONS

The moose population Unit 16B fell outside of objective levels by the fall of 1999–00 (Griese 2000) and continues to decline. Our estimate of 3700–4000 moose is below the minimum objective of 6500 and well below what the habitat could support. Current season and bag limit structure is adequate to allow bull:cow ratios to remain above minimum objective levels. If the moose density continues to decline, we should be cautious to maintain bull:cow ratios at or above 25 bulls:100 cows (Griese 2000).

Future efforts should be directed at gaining accurate and precise estimates of predator populations. Also, starting a long-term monitoring program of the unit's moose browse will provide needed empirical data to further clarify whether predators or habitat is more limiting in this declining moose population. We should continue to campaign for prescribed burns including a potential controlled site near Sucker Creek on the north side of Mount Susitna which has been identified for over 7 years (Griese 2000).

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Table 1 Unit 16B fall aerial moose composition counts and estimated subpopulation sizes, 1990–2001

Reg. year	Area	Date	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Percent calves	Adults	Total moose observed	Moose observed: mi ²	Population estimate
1990–91	Northern ^a	11/21–27	32	9	23	15	650	745	1.4	2650±412 ^b
	Middle ^a	12/08–21	34	5	25	16	673	789	1.4	3824±314 ^b
1991–92 ^c			--	--	--	--	--	--	--	--
1992–93	Southern ^d	12/15	36	5	12	12	109	124	--	--
1993–94	Northern ^e	11/15–20	50	10	16	10	374	416	1.1	2006±432 ^b
	Middle ^e	11/28–12/3	21	9	25	17	391	463	1.4	3653±1965 ^b
1994–95	Northern ^f	11/13–18	42	10	12	7	405	431	1.0	--
	Middle ^f	11/18–25	26	4	24	16	314	374	--	--
	Southern ^g	11/29–12/2	25	5	25	17	220	261	1.0	810–1210
	Kalgin Is. ^h	11/18	35	15	65	33	27	40	1.7	55–75
1995–96	Northern ^d	2/27–28	--	--	--	7	298	321	--	--
	Middle ^d	2/27–28	--	--	--	12	855	969	--	--
	Southern ^d	2/29–3/3	--	--	--	6	505	537	0.8	1081±145 ^b
	Kalgin Is. ^f	2/09	--	--	--	28	26	36	1.5	60–90
1996–97	Northern ^a	11/1–2	38	7	23	14	422	484	1.2	1912±325
	Southern ^d	11/8–9	32	7	14	10	305	338	--	--
	Kalgin Is. ^f	11/8	67	27	60	26	25	35	1.5	80–110
1997–98	Southern ^d	11/25, 12/3	37	8	13	9	544	591	--	--
	Kalgin Is. ^f	2/27	--	--	--	23	17	22	0.9	100–130

Table 1 Continued

Reg. year	Area	Date	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Percent calves	Adults	Total moose observed	Moose observed /mi ²	Population estimate
1998–99	Southern ^d	11/22	35	7	8	6	337	357	--	--
	Kalgin Is. ^h	12/7	27	9	36	29	82	116	5.0	130–150
1999–00	Middle ^a	11/22–27	28	2	9	7	587	631	1.3	3314±489 ^b
	Southern ^d	11/15–22	38	4	8	6	432	458	--	--
	Kalgin Is. ^h	01/5	--	--	--	24	38	50	2.2	60–80
2000–01	Northern ^e	11/20–22	39	5	7	5	253	268	0.6	909±184
	Southern ^d	12/16	--	--	--	--	85	98	--	--
	Kalgin Is. ^h	12/12	--	--	--	30	35	50	2.2	80–100
2001–02	Northern ^e	11/5–7	40	7	14	9	393	438	0.8	1187±182
	Middle ^e	11/8–11	32	4	10	7	494	537	0.7	1836±267
	Southern ^d	10/30–11/4	31	3	13	9	539	594	--	700–850
	Kalgin Is. ^h	10/22	--	--	--	33	64	96	4.2	110–140

^a Gasaway et. al. (1986) random stratified survey^b 80% confidence intervals^c No count^d Trend area composition survey (2–4 min./mi²)^e Becker survey (Becker and Reed 1990)^f Sex and age composition survey (4–6 min./mi²)^g J. VerHoef's regression sampling method for 1/3 of area (612 ± 151 (80% CI)) plus 350–550 estimated for remainder of area^h Sex and age composition survey (6–8 min./mi²)

Table 2 Unit 16B annual moose harvest and accidental death, 1990–2001

Regulatory year	Reported				Estimated			Accidental			Grand Total
	M	F	Unk	Total	Unreported	Illegal ^a	Total	Road	Other	Total	
1990–91	93	5	1	99	10	25	35	2	0	2	136
1991–92	262	0	0	262	15	25	40	1	0	1	303
1992–93	234	1	3	238	15	25	40	0	0	0	278
1993–94	155	21	0	176	10	35	45	0	0	0	221
1994–95	230	0	0	230	15	35	50	2	3	5	285
1995–96	187	11	2	200	10	25	35	0	0	0	235
1996–97	293	9	3	305	20	25	45	1	0	1	351
1997–98	314	13	1	328	20	25	45	1	0	1	374
1998–99	288	7	1	296	20	30	50	0	0	0	346
1999–00	297	50	4	351	20	25	45	0	0	0	396
2000–01	264	42	0	306	20	25	45	0	0	0	351
2001–02	130	21	0	151	20	25	45	0	0	0	196

^a Includes moose taken in defense of life or property

Table 3 Unit 16B moose harvest data by permit hunt, 1993–2001

Hunt Nr. ^a	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest		
						Bulls	Cows	Total
TM565	1993–94	30	13	10	73	7	15	22
	1994–95	138	32	23	40	55	0	55
	1995–96	140	40	46	10	14	0	14
	1996–97	141	26	38	35	49	0	49
	1997–98	139	30	32	37	50	1	51
	1998–99	140	21	39	37	52	0	52
	1999–00	140	22	31	41	57	0	57
	2000–01	140	16	54	31	43	0	43
	2001–02	140	29	41	30	42	0	42
TM567	1993–94	15	33	0	67	4	6	10
	1994–95	59	19	14	66	39	0	39
	1995–96	60	30	58	7	4	0	4
	1996–97	60	18	30	49	30	0	30
	1997–98	59	12	38	48	29	0	29
	1998–99	60	17	37	42	25	0	25
	1999–00	60	13	18	58	35	0	34
	2000–01	60	25	37	38	23	0	23
	2001–02	160	31	41	28	44	0	44
TM569	1993–94	60	45	35	20	12	0	12
	1994–95	58	43	29	17	10	0	10
	1995–96	60	32	47	18	8	1	11
	1996–97	60	45	25	28	16	0	17
	1997–98	59	53	24	17	9	1	10
	1998–99	60	30	42	25	15	0	15
	1999–00	60	35	37	20	12	0	12
	2000–01	60	50	42	8	5	0	5
	2001–02	100	42	27	31	31	0	31

Table 3 Continued

Hunt Nr.	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest		
						Bulls	Cows	Total
RM572	1999-00	437	37	42	18	30	50	80
	2000-01	355	32	50	18	22	42	64
	2001-02	142	30	48	22	10	21	31

^aTM = Tier II permit, RM = registration permit.

Table 4 Unit 16B moose hunter^a residency and success 1990–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Total	(%)	Local resident	Nonlocal resident	Nonresident	Total	(%) ^b	
1990–91	3	64	2	69	(16)	24	325	1	350	(840)	419
1991–92	13	153	35	201	(26)	24	514	41	579	(74)	780
1992–93	14	136	38	193	(25)	26	480	53	570	(75)	763
1993–94	15	78	36	132	(23)	28	358	40	437	(77)	570
1994–95	5	82	38	126	(23)	23	352	35	413	(77)	539
1995–96	4	116	38	161	(25)	28	406	44	485	(75)	646
1996–97	11	145	39	199	(30)	24	410	31	465	(70)	664
1997–98	12	165	48	229	(32)	21	419	36	479	(68)	708
1998–99	7	152	37	196	(25)	25	497	53	575	(75)	771
1999–00	7	117	40	168	(22)	26	508	62	596	(78)	764
2000–01	10	129	30	171	(22)	20	535	60	619	(78)	790
2001–02 ^c	--	--	--	--	--	--	--	--	--	--	--

^a Does not include individuals participating in permit hunts^b Unit 16 residents^c No general open season

Table 5 Unit 16B moose harvest chronology^a by months of season, 1990–2001

Year	August		September					January	Unknown	Total
	20–25	26–31	1–6	7–12	13–18	19–24	25–30	10–23		
1990–91	--	--	40	17	--	--	--	--	12	69
1991–92 ^c	--	--	56	33	80	27	--	--	8	204
1992–93 ^c	--	--	45	52	58	28	--	--	9	192
1993–94	10	6	9	24	46	20	--	9	7	131
1994–95 ^e	16	11	11	36	36	12	--	--	4	126
1995–96 ^f	13	7	14	20	31	32	40	--	3	160
1996–97 ^f	8	17	16	20	40	42	51	--	5	199
1997–98 ^f	11	12	20	16	52	53	56	--	9	229
1998–99 ^f	12	10	14	20	31	44	59	--	7	197
1999–00	5	1	8	17	34	45	51	--	8	169
2000–01	6	5	10	17	37	55	40	--	4	174
2001–02	--	--	--	--	--	--	--	--	--	--

^a Does not include harvest from permit hunts

^b Open season = Sep 1–10

^c Open season = Sep 1–20

^d Open season = Aug 20–Sep 20 (SF/50), Jan 10–23 (SF/50 – Res. only)

^e Open season = Aug 20–Sep 20 (SF/50)

^f Open season = Aug 20–Sep 30 (SF/50); Kalgin Island = Aug 20–Sep 20 (Any bull)

^g Open season = Aug 20–Sep 30 (SF/50)

^h No general open season

Table 6 Transport method used by successful moose hunters^a in Unit 16B, 1990–2001

Regulatory year	Percent of successful moose hunters								Nr moose harvested
	Airplane	Horse	Boat	3-or 4- Wheeler	Snowmachine	ORV	Highway vehicle	Unk	
1990–91	65	0	19	1	3	3	4	4	69
1991–92	68	1	22	4	0	1	2	2	204
1992–93	64	3	19	4	0	3	2	5	192
1993–94	56	11	21	1	6	1	0	4	131
1994–95	60	11	17	3	1	1	1	6	126
1995–96	67	9	19	3	0	1	0	1	160
1996–97	61	9	18	6	1	3	1	3	199
1997–98	62	6	19	4	0	2	3	3	229
1998–99	55	7	25	8	0	2	1	2	197
1999–00	60	5	19	9	0	2	2	2	169
2000–01	65	3	21	7	0	1	2	2	174
2001–02 ^b	--	--	--	--	--	--	--	--	--

^a Does not include harvest from permit hunts

^b No general open season

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
JUNEAU, AK 99802-5526

MOOSE MANAGEMENT REPORT

From: 1 July 1999

To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 17 (18,800 mi²)

GEOGRAPHIC DESCRIPTION: Northern Bristol Bay

BACKGROUND

Moose are relatively new inhabitants in the Bristol Bay area, possibly immigrating into the area from middle Kuskokwim River drainages during the last century. Until recently, populations were low and moose primarily inhabited the Nushagak/Mulchatna River system. Local residents harvested moose opportunistically; however, caribou, reindeer, bears, and beaver were historically the main sources of game meat. The department began collecting data on the Unit 17 moose population in 1971. At that time, Faro (1973) reported that moose were not abundant in the unit and that animals close to the villages were subject to heavy hunting pressure.

Hunting seasons have varied over the years, but the bag limit has always been restricted to bulls. In the past, a general disregard for seasons and bag limits by unit residents was suspected to be the principal factor contributing to low densities of moose in the unit (Taylor 1990).

In the last two decades moose populations throughout Unit 17 have increased substantially in number and range. Reasons for this increase include moderate snowfalls in several successive winters and decreased human harvest of female moose. The reduction in the female harvest was caused in part by a positive response by unit residents to department education efforts and an abundance of an alternative big game resource as the Mulchatna caribou herd grew and extended their range (Van Daele 1995).

Moose are now common along the Nushagak/Mulchatna Rivers and all of their major tributaries. They are also throughout the Wood/Tikchik Lakes area. Moose have successfully extended their range westward into the Togiak and Kulukak River drainages of Unit 17A, where a viable population has become established in the last 7 years.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Unit 17A

Establish a minimum population of 100 moose and a target population of 600–1000 moose

Unit 17B

Achieve and maintain a density of 1 moose/mi² on habitat considered good moose range

Unit 17C

Maintain a minimum density of 0.5 moose/mi²

METHODS

Moose populations in Unit 17A were monitored in cooperation with personnel from the Togiak National Wildlife Refuge (TNWR). Movements along the border of Units 17A and 17C were monitored during a radiotelemetry study from 1989 to 1994. In March 1998, 36 moose were radiocollared in Unit 17A to study movements and population parameters (Aderman, et. al.1999). Late winter aerial surveys of the Unit 17A were conducted during this reporting period.

Aerial surveys of trend count areas in Units 17B and 17C have been used in the past to sample sex and age composition and to collect data on population trends in representative portions of the unit. Optimal survey periods were from 1 November–15 December when moose were established on their winter ranges and bulls still had their antlers. In most years, however, suitable weather, snow cover, and survey aircraft were not available during the optimal period. Late fall composition surveys in the upper Nushagak and Mulchatna River drainages were initiated in 1992–93 to investigate population trends, but have not been conducted since 1998.

Moose population estimation surveys have been attempted six times in portions of Units 17B and 17C. A portion of Unit 17C was surveyed in 1983. In 1987 a portion of the upper Mulchatna River area in Unit 17B was surveyed, and in 1995 western 17C along with most of 17A were surveyed. In March 1999, a population estimation survey for entire Unit 17C was completed using a spatial statistics stratification model. In March 2001, a population estimation survey for the western portion of Unit 17B (upper Nushagak River drainage) was completed using a spatial statistics stratification model

We collected harvest data by means of harvest ticket reports and registration permit reports. Nonreporting hunters were contacted by telephone and were sent reminder letters. We monitored harvest and cooperated with enforcement efforts of Fish and Wildlife Protection during the hunting season.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Aderman et. al. (1995) estimated there were approximately 100 moose in Unit 17A and the portion of Unit 17C surveyed in 1995. In March 2000 and 2001, department staff and TNWR staff surveyed in Unit 17A, east of and including the Matogak River drainage and north of the Nushagak Peninsula, counting 422 moose in 2000 and 471 in 2001. The present population size in Unit 17A likely exceeds 500 moose (Aderman et. al. 2000). We have seen a continued increase in the number of moose in the unit since the early surveys.

The moose population in Unit 17B was estimated to be 2500–3000 moose in 1987 (Taylor 1990). That estimate was based on extrapolations from a survey in the upper Mulchatna River area. Assuming that 50% of the unit is good moose habitat, we established the management goal for the unit at 4900 moose. Survey data for this unit were inconsistent and difficult to interpret. Taylor (1988) noted that trend count data were of limited use in estimating moose density in Unit 17 and periodic population estimation surveys were the only objective method of assessing trends. Lacking such information, we conducted late winter surveys of major drainages to investigate population trends between 1992 and 1997 (Tables 1–2). From the available data, it appeared the moose population size in the unit was stable to increasing. In March 2001, I conducted a moose population estimation survey in the western portion of Unit 17B including the upper Nushagak River drainage and drainages of Lake Kulik and Lake Beverley. Ninety-five (95) of 441 sample units were surveyed, yielding an extrapolated estimate of 1202 (± 141 at 90% CI) moose, including 61 (± 9 at 90% CI) calves (5.1% of moose). Extrapolating this estimate to the entire subunit indicates the Unit 17B moose population is at less than half the population management objective.

The moose population in Unit 17C was estimated to be 1400–1700 moose in 1987 (Taylor 1990). That estimate was based on extrapolations from the moose survey conducted in 1983. The management objective for the unit is about 1750 moose. In March 1999, I conducted a moose population estimation survey for Unit 17C north of the Igushik River. One hundred and three (103) of 774 sample units were surveyed, yielding an extrapolated estimate of 2955 (± 488 at 90% CI) moose, including 435 (± 76 at 90% CI) calves (14.7% of moose). This estimate indicates the Unit 17C moose population is at the population management objective.

Population Composition

Bull:cow ratios in all areas of Unit 17 have historically been high, but no composition data were collected during this reporting period. Calf production and survival have fluctuated between areas and years. In 1997–98, late winter survey data indicated minimum calf percentages of 19.4% in the Mulchatna drainages and 24.9% in the upper Nushagak drainages. The 1999 survey indicated a minimum calf percentage of 14.7% in Unit 17C and the 2001 survey indicated a minimum calf percentage of 5.1% in western Unit 17B.

Distribution and Movements

Much of Unit 17 is wet or alpine tundra, and moose are located predominantly along the riparian areas. We know little about specific movement patterns, except that they are influenced primarily by the rutting season in late September and by snow conditions in early winter.

Data from a joint ADF&G–TNWR radiotelemetry study indicated that most moose radiocollared in western Unit 17C stayed in that area, but there was some movement into Unit 17A. One radiocollared moose and her calf moved from Weary River to Kulukak River (Jemison 1994). During the February 1995 population estimation survey, 29 moose moved into 17A from the upper Sunshine Valley in 17C (Aderman et al. 1995). Aderman et al. (2000) found that in Unit 17A, some radiocollared moose remained in the same range during winter and summer, while other radiocollared moose used different ranges during those seasons.

MORTALITY

Harvest

Season and Bag Limit. Unit 17A was open to resident/subsistence hunters only by registration permit August 20 to September 15 (RM573). Registration permit holders could take 1 bull, regardless of antler size.

Unit 17B was divided into 2 sections: the Mulchatna River drainage upstream and including the Chilchitna River and the remainder of the unit. The upstream section was open for resident hunters from September 1–15 and nonresident hunters from September 5–15. The remainder of Unit 17B was open to resident hunters during September 1–15, September 5–15 for nonresidents, and for resident hunters with a registration permit from August 20 to September 15 (RM583) and during December 1–31 (RM585). The nonresident bag limit was 1 bull with 50" or greater antler spread or with 4 or more brow tines on at least 1 side. The bag limit for residents was 1 bull with spike/fork or 50" antlers (3+ brow tines). Registration permit holders could take 1 bull, regardless of antler size.

Unit 17C was also divided into 2 sections: the Iowithla River drainage, Sunshine Valley, and all portions of the unit west of the Wood River and south of Aleknagik Lake and the remainder of the unit. Open season for resident hunters was from September 1–15 throughout the unit. An additional resident-only registration permit hunting season was open in the remainder of the unit from August 20 to September 15 (RM583) and during December 1–31 (RM585). Nonresidents were prohibited from hunting in Unit 17C. The bag limits in 17C were the same as in 17B.

Registration hunt RM 573 permits were valid only in Unit 17A, and were available to any Alaska resident who applied in person at Togiak (August 5–September 15). Registration hunt RM583 and RM585 permits were valid for both 17B and 17C. Permits were available to any Alaska resident who applied in person at Dillingham (RM583: July 15–August 31, RM585: October 25–December 31).

Board of Game Actions and Emergency Orders. In March 2001 the Board of Game passed a regulation requiring all nonresident moose hunters in Unit 17B attend a department-approved hunter orientation course (to include trophy recognition and meat care) or must be accompanied by a registered guide or resident family member within the second degree of kindred.

During the March 1999 Board of Game meeting, the board identified moose in Units 17B and 17C as populations important for providing high levels of harvest for human consumption. During the March 2001 Board of Game meeting, the board established a population objective of 4,900 to 6,000 and harvest objective of 200 to 400 moose in Unit 17B for intensive management purposes. The board established a population objective of 2,800 to 3,500 and harvest objective of 165 to 350 moose in Unit 17C for intensive management purposes.

Hunter Harvest. Because of an almost four-fold increase in hunters afield since 1983 (1983/84–293; 2000/01–1112), reported moose harvests in Unit 17 have more than tripled during the past 18 years (1983/84–127; 1999/00–425). The total harvest in the past 5 years in Unit 17B has ranged from 168 to 226, with an annual average harvest of 188 moose. In Unit 17C the 5-year mean annual harvest was 148, with a range of 113 to 192 moose (Table 3).

Hunters continued to harvest moose with large antlers throughout this reporting period. During each of the last 7 seasons, over 56% of the reported harvest has consisted of moose with antler spreads of 50" or greater. The largest antlers reported for each of these seasons have exceeded 70" (Table 4).

General Hunt. The general moose hunt in Unit 17B and 17C is of shorter duration and with more restrictive bag limits than the registration hunts. Greater numbers of nonlocal Alaska residents and nonresidents hunt moose during this hunt than local (Unit 17) Alaska residents (Table 5). Unit 17A has not had an open general moose hunting season since 1980–81; however, 10–25 moose of both sexes were probably killed annually (Table 6). The reported harvest in the past 5 years for the general moose season in Unit 17B has ranged from 122 to 171, with a mean annual harvest of 145 moose (Table 7). In Unit 17C, the 5-year mean annual harvest for the general hunt has been 22 moose, with a range of 18 to 27 (Table 8).

Permit Hunts. Longer seasons and more liberal bag limits have enticed many resident hunters to participate in the registration hunts (RM573, RM583, and RM585). By 1999, 749 hunters received permits, and 612 hunters reported hunting, killing 279 moose (Table 9).

During the third legal hunting season in Unit 17A (1999), 41 hunters reported killing 10 moose; the following season, 2000, 49 hunters reported killing 10 moose (Table 10). In 1999, in Units 17B and 17C, 749 hunters received registration hunt permits, 571 reported hunting and 269 moose were killed. In 2000, in Units 17B and 17C, 685 hunters receiving registration hunt permits, 526 reported hunting and 179 moose were killed (Tables 11 and 12).

Hunter Residency and Success. The mean number of moose hunters participating in the general moose hunting season in Unit 17 during the past 5 years was 497, an increase from the previous reporting period (Woolington 2000). Participation by resident hunters in the general hunt has declined because of increased interest in the registration hunt. Nonresident participation continued to increase, despite more restrictive regulations from earlier years. Unitwide success during the general hunt ranged from 29% to 40% during the past 5 years, with a mean annual success rate of 34%. In regulatory years 1996-97 through 2000-01, nonresidents accounted for 66% of reporting hunters, residents of Unit 17 8%, and other residents of Alaska made up 25% of the total number of hunters in the general hunt (Table 5).

The mean number of moose hunters participating in registration moose hunts in Unit 17 during the past 5 years was 533, a 27% increase from the previous reporting period (Woolington 2000). Success during the registration hunts in Unit 17 ranged from 33% to 46% during the past 5 years, with a mean annual hunter success rate of 40%. Residents of Unit 17 composed 78%, and other residents of Alaska made up 22% of hunters in the registration hunts from regulatory years 1996-97 through 2000-01 (Table 9).

Harvest Chronology. Because of changes in seasons and weather, chronology data did not indicate consistent patterns (Table 13 and 14). Unit residents were the main participants in the August and December seasons. These seasons were originally established to provide local residents an opportunity to harvest moose that were not rutting. The regulatory intent was to discourage the illegal killing of female moose and harvests during closed seasons.

Transport Methods. Aircraft were the primary means of access for moose hunters in the general hunt in Unit 17 (5-yr mean = 67%, Table 15). Most participants in the registration hunt used boats for access (5-yr mean = 74%, Table 16). In 1990–91, off-road vehicles, including 3- and 4-wheelers, became prohibited modes of transportation for big game hunters in Unit 17B.

Other Mortality

Predation by wolves and bears occurred regularly throughout this reporting period. Reports from local resident and nonlocal hunters suggest wolf numbers appeared to be increasing unit wide, and brown bears are common. Snow depths throughout the unit were moderate during the winters of this reporting period, and there were no reports of excessive winter mortality. Moose were apparently able to find abundant forage on winter ranges in riparian areas.

There was one report of a moose being killed by a motor vehicle on the Aleknagik Lake Road near Dillingham during this reporting period. The meat was salvaged for human consumption.

Illegal harvest continued to be a problem in Unit 17A. Unit residents actively pursued moose with snowmachines during the winter and spring. Both male and female moose were taken. However, illegal harvests in Units 17B and 17C have decreased dramatically in the past 10 years. There has also been a significant decline in the number of female moose taken. It is now common to see moose near Nushagak River villages throughout the winters.

HABITAT

Assessment

Aderman (1999) established 7 intensive mapping areas in Unit 17A, based on computer-aided analysis of Landsat photos. He visited 104 sites for ground-truthing in July 1998. Information collected included dominant vegetation species, slope, aspect, and drainage. Aderman (1999) estimated a minimum of 560 mi² of optimal moose winter habitat and another 520 mi² of secondary moose winter habitat in Unit 17A.

No formal habitat-monitoring programs were conducted in the remainder of Unit 17. Moose winter ranges along the Nushagak and Mulchatna Rivers, and along the lower reaches of the major tributaries to those rivers, are probably in good condition. Although there is evidence of heavy browsing, willow stands on gravel bars are abundant and include a good mix of brush heights. Winter range conditions in the middle and upper reaches of the tributaries have not been assessed but are probably not as productive.

Enhancement

No habitat enhancement activities have been documented in Unit 17. Because of the relative inaccessibility of most of the unit and the occurrence of natural habitat change, man-caused habitat enhancement activity is not practical or necessary.

Lightning-caused wildfires are not uncommon in the unit, particularly in Unit 17B. During this reporting period, there were no large wildfires.

In most years the most important natural force responsible for enhancing moose habitat was the scouring of gravel bars and low-lying riparian areas by ice and water during spring thaw. This was especially true for the Nushagak and Mulchatna Rivers and the lower reaches of the major tributaries to those rivers.

NONREGULATORY MANAGEMENT PROBLEMS

Dramatic increases in the number of caribou in the Mulchatna herd through the mid 1990s impacted the moose population in this unit, though there was little direct competition between these ungulates. Short-term impacts of large caribou populations include decreased illegal moose harvest by local residents and increased hunting pressure by other residents and nonresidents interested in combination hunts for moose and caribou. The most significant long-term impact on moose may be the response of predator populations to abundant prey resources. Wolf numbers increased in the unit during this reporting period. There were few instances of wolves following the caribou herd, so when the herd moved out of a pack's territory, moose became the primary source of meat for wolves. The same prey shift can be expected when the caribou herd crashes.

CONCLUSIONS AND RECOMMENDATIONS

Predation by wolves, bears, and humans continued to increase in recent years. Good browse conditions and a continuing series of average winters resulted in stable-to-increasing moose populations in Units 17A and 17C during this reporting period. The moose population has exceeded the minimum goal in Unit 17A and is approaching the management objective. The first reliable population estimate for a substantial portion of Unit 17B was achieved during this reporting period. Moose numbers in Unit 17B, however, are probably in decline as evidenced by the poor calf recruitment. A reliable population estimation survey for Unit 17C in 1999 indicated the population in 17C has reached or exceeded the management objective. Although objective habitat evaluations were lacking for most of the unit, it appeared that browse quality and quantity were sufficient to support the population on most of the winter ranges.

Fall trend counts were notoriously unreliable in providing consistent data on moose populations in Unit 17. Suitable survey conditions, including complete snow coverage, light winds, and moose movements onto winter range, rarely occur before antler drop. Periodic population estimation surveys of portions of the unit during late winter provide the best moose population information. Unfortunately it does not provide reliable information on sex or age composition.

Moose hunting activity and harvest have increased in Unit 17 during the past decade. The increased number of caribou in the area has contributed to more nonlocal hunters along the Nushagak/Mulchatna River drainages. Hunting methods and harvest chronology have remained consistent in recent years, so the increased harvest is indicative of increased effort.

The moose population in Unit 17A has increased dramatically in recent years. Unit residents anxious to take advantage of this increase were given that opportunity during the 1997–98 season. We worked with local residents and with staff from TNWR, and developed a draft moose management guideline that establishes an objective of 600–1000 moose in the unit. We also entered into a cooperative moose research project with TNWR in March 1998 to 1) document population trends, 2) evaluate the moose habitat in the unit and estimate carrying capacity, and

3) develop appropriate management goals and regulatory proposals. It is critical that these cooperative efforts be coupled with continued efforts to curtail illegal harvest of moose in the Togiak valley.

The Board of Game had considered impacts of liberalized caribou seasons on the Unit 17 moose population and adjusted the moose season for 1993–94, and the board adjusted it again in 1997. The board and the department will need to continue managing these 2 ungulate populations and monitoring predator populations.

Recommended management actions for the next few years include the following:

- 1 Establish moose survey areas within Unit 17 and attempt to conduct a population estimation survey area each winter on a rotating basis;
- 2 Develop a final moose management plan for Unit 17A in cooperation with Togiak National Wildlife Refuge, local advisory committees, and local citizen groups;
- 3 Continue to manage Unit 17 moose populations conservatively as long as large numbers of hunters are attracted to the area in pursuit of Mulchatna caribou;
- 4 Continue to seek cost-effective and accurate methods to obtain bull:cow ratios within the unit.

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Table 1 Unit 17B, Upper Mulchatna river drainages moose trend count areas, late winter aerial moose counts, 1992/93–1998/99

Regulatory Year	Survey area				Survey Total	Moose/ hour	Relative Snow Level ^b
	Mulchatna River ^a	Mosquito River	Stuyahok River	Old Man River			
1992–93 ^c	304	64	13	126	507	194.3	moderate
1993–94 ^d	201	47	6	102	356	114.5	low
1994–95 ^{fe}	354	96	9	83	542	140.1	moderate
1995–96 ^f	62 ^f	14	4	---	90	52.9	very low
1996–97 ^g	---	--	--	---	0	---	bare ground
1997–98 ^h	354	96	9	83	484	258.1	deep
1998–99 ⁱ	---	--	--	---	---	---	low

^a Survey area encompasses the Mulchatna River from its mouth to Red Veils, including all riparian habitat within 1 mile of the river.

^b Subjective evaluation of snow depths within the vicinity of the survey area (actual depths are recorded in field notes)

^c Mulchatna River drainages surveyed on 25 Jan. 1993, other drainages surveyed on 9 Feb. 1993.

^d Mulchatna River drainages surveyed on 15 Mar. 1994, other drainages not surveyed.

^e Mulchatna River drainages surveyed on 23 Feb. 1995, other drainages surveyed 24 Jan. 1995.

^f All drainages surveyed on 11 March 1996. Mulchatna and Old Man surveys were aborted due to bare ground.

^g No survey conducted due to extremely low snow levels and a preponderance of bare ground.

^h All drainages surveyed on 23 January 1998.

ⁱ No surveys conducted in 1999

Table 2 Units 17B and 17C, Upper Nushagak, Nuyakuk, and Wood river drainages moose trend count areas, late winter aerial moose counts, 1992/93–1998/99

Regulatory Year	Survey area				Survey Total	Moose/ hour ^d	Relative Snow Level ^e
	Nushagak River ^a	Nuyakuk River ^b	King Salmon River ^b	Wood River ^c			
1992–93 ^f	319	12	--	19	350	203.2	moderate
1993–94 ^g	---	--	--	--	0	---	low
1994–95 ^h	484	4	--	42	530	281.4	moderate
1995–96 ⁱ	401	7	26	--	434	253.8	very low
1996–97 ^j	---	--	--	--	0	---	bare ground
1997–98 ^k	882	--	--	--	882	363.0	deep
1998–99 ^l	---	--	--	--	---	---	low

^a Survey area encompasses the Nushagak River from its Koliganek to Big Bend, including all riparian habitat within 1 mile of the river. Entire survey area is within unit 17B.

^b Survey area within unit 17B.

^c Survey area within unit 17C.

^d Moose per hour analysis only includes the Nushagak River portion of the survey.

^e Subjective evaluation of snow depths within the vicinity of the survey area (actual depths are recorded in field notes)

^f All areas surveyed on 3 February 1993.

^g No survey conducted.

^h All areas surveyed on 24 January 1995.

ⁱ All areas surveyed on 6 March 1996.

^j No survey conducted due to extremely low snow levels and a preponderance of bare ground.

^k All drainages surveyed on 5 February 1998.

^l No surveys conducted in 1999

Table 3 Reported moose harvest data for all hunts in Unit 17, 1964/65–2000/01

Regulatory year	Reported Harvest	Hunters afield	Success rate	Unit ^a			
				17A	17B	17C	Unk
1964–65	32	---	---	---	---	---	---
1965–66	42	---	---	---	---	---	---
1966–67	26	90	29%	---	---	---	---
1967–68	38	77	49%	---	---	---	---
1968–69	46	66	70%	---	---	---	---
1969–70	15	31	48%	---	---	---	---
1970–71	25	35	71%	---	---	---	---
1971–72	37	63	59%	---	---	---	---
1972–73	38	74	51%	---	---	---	---
1973–74	42	93	45%	---	---	---	---
1974–75	69	119	58%	---	---	---	---
1975–76	115	207	56%	---	---	---	---
1976–77	49	168	29%	---	---	---	---
1977–78	54	113	48%	---	---	---	---
1978–79	65	160	41%	---	---	---	---
1979–80	33	68	49%	---	---	---	---
1980–81	89	212	42%	---	---	---	---
1981–82	76	209	36%	---	---	---	---
1982–83	49	149	33%	---	---	---	---
1983–84	127	293	43%	0	72	48	0
1984–85	158	344	46%	0	86	70	0
1985–86	148	401	37%	0	94	52	0
1986–87	202	486	42%	0	122	73	0
1987–88	207	499	42%	0	152	42	0
1988–89	187	457	41%	0	157	28	0
1989–90	175	438	40%	0	122	48	0
1990–91	225	489	46%	0	178	44	0
1991–92	268	590	45%	0	172	85	0
1992–93	263	705	47%	0	160	90	13
1993–94	249	705	35%	1	150	78	20
1994–95	296	800	37%	0	167	94	69
1995–96	336	881	38%	0	192	109	35
1996–97	373	913	41%	0	207	113	53
1997–98	347	956 ^b	36%	15	168	126	38
1998–99	389	1048 ^b	37%	10	168	171	40
1999–00	425	1116 ^b	38%	10	170	192	53
2000–01	373	1112 ^b	34%	10	226	136	1

^a Harvest data not broken down by unit before 1983–84.^b Included hunters who registered for both fall and winter registration hunts.

Table 4 Unit 17 moose antler sizes (percent) in the reported harvest, 1992/93–2000/01

Regulatory Year	Antler size			Largest antlers
	<30"	30–50"	>50"	
1992–93	6	36	57	80"
1993–94	3	30	68	73"
1994–95	9	29	62	73"
1995–96	7	35	57	78"
1996–97	9	26	65	75"
1997–98	6	36	57	73"
1998–99	9	35	56	74"
1999-00	7	37	56	71"
2000-01	8	27	65	80"

Table 5 Unit 17 moose hunter^a residency and success, 1992/93–2000/01

Regulatory Year	Successful				Unsuccessful				Total hunters
	Local Resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total(%)	
1992–93	61	79	64	212 (41) ^b	65	114	124 ^b	310 (59) ^b	522
1993–94	21	28	93	144 (33) ^c	27	117	142 ^c	292 (67) ^c	436
1994–95	22	41	91	161 (33) ^d	24	117	180 ^d	329 (67) ^d	490
1995–96	23	30	115	171 (35) ^e	28	103	177 ^e	314 (65) ^e	485
1996–97	16	35	144	196 (40) ^f	33	82	174 ^f	291 (60) ^f	487
1997–98	13	33	100	150 (35) ^g	29	79	161	277 (65) ^g	427
1998–99	15	34	120	169 (32)	27	111	220	359 (68) ^h	528
1999-00	16	26	99	146 (29) ⁱ	20	91	235	358 (71) ⁱ	504
2000-01	4	41	139	184 (34)	18	98	236	353 (66) ^j	537

^a Excludes hunters in permit hunts.

^b Includes 8 successful and 7 unsuccessful hunters of unknown residency.

^c Includes 2 successful and 6 unsuccessful hunters of unknown residency.

^d Includes 7 successful and 8 unsuccessful hunters of unknown residency.

^e Includes 3 successful and 6 unsuccessful hunters of unknown residency.

^f Includes 1 successful and 2 unsuccessful hunters of unknown residency.

^g Includes 4 successful and 8 unsuccessful hunters of unknown residency.

^h Includes 1 unsuccessful hunter of unknown residency.

ⁱ Includes 5 successful and 12 unsuccessful hunters of unknown residency.

^j Includes 1 unsuccessful hunter of unknown residency.

Table 6 Unit 17A moose harvest^a and accidental death, 1992/93–2000/01

Regulatory year	Hunter Harvest							Accidental death	Grand total
	Reported				Estimated				
	M (%)	F (%)	Unk.	Total	Unreported	Illegal	Total		
1992–93	0	0	0	0	0	10	10	0	15
1993–94	1 (100)	0	0	1	0	20	20	0	21
1994–95	0	0	0	0	0	25	25	0	25
1995–96	0	0	0	0	0	15	15	0	15
1996–97	0	0	0	0	0	10	10	0	10
1997–98	0	0	0	0	0	10	10	0	10
1998–99	0	0	0	0	0	10	10	0	10
1999-00	0	0	0	0	0	10	10	0	10
2000-01	0	0	0	0	0	10	10	0	10

^a Excludes permit hunt harvest.Table 7 Unit 17B reported moose harvest^a and accidental death, 1992/93–2000/01

Regulatory Year	Hunter Harvest							Accidental death	Grand total
	Reported				Estimated ^b				
	M (%)	F (%)	Unk.	Total	Unreported	Illegal	Total		
1992–93	152 (100)	0	0	152	0	0	0	0	152
1993–94	125 (100)	0	1	126	0	0	0	0	126
1994–95	132 (100)	0	0	132	0	0	0	0	132
1995–96	148 (100)	0	0	148	0	0	0	0	148
1996–97	171 (100)	0	0	171	0	0	0	0	171
1997–98	127 (100)	0	0	127	0	0	0	0	127
1998–99	139 (100)	0	0	139	0	0	0	0	139
1999-00	122 (100)	0	0	122	0	0	0	0	122
2000-01	165 (100)	0	0	165	0	0	0	0	165

^a Excludes permit hunt harvest.^b No estimates of unreported/illegal harvests have been made for this unit.

Table 8 Unit 17C reported moose harvest^a and accidental death, 1992/93–2000/01

Regulatory Year	Hunter Harvest							Accidental death	Grand total
	Reported				Estimated ^b				
	M (%)	F (%)	Unk.	Total	Unreported	Illegal	Total		
1992–93	56 (100)	0	0	56 ^c	0	0	0	0	56
1993–94	18 (100)	0	0	18	0	0	0	0	18
1994–95	28 (100)	0	0	28 ^d	0	0	0	1 ^e	29
1995–96	32 (100)	0	0	22 ^f	0	0	0	0	22
1996–97	23 (100)	0	0	23 ^g	0	0	0	2 ^h	25
1997–98	21 (100)	0	0	21 ⁱ	0	0	0	0	21
1998–99	27 (100)	0	0	27 ^j	0	0	0	1	28
1999-00	23 (100)	0	0	23 ^k	0	0	0	0	23
2000-01	18 (100)	0	0	18 ^l	0	0	0	1	19

^a Excludes permit hunt harvest.

^b No estimates of unreported/illegal harvests have been made for this unit.

^c Does not include 3 bulls from an unspecified portion of Unit 17.

^d Does not include 1 bulls from an unspecified portion of Unit 17.

^e Includes 1 bull killed in defense of life or property.

^f Does not include 3 bulls from an unspecified portion of Unit 17.

^g Does not include 11 bulls from an unspecified portion of Unit 17.

^h Does not include 1 cow and 1 bull killed in motor vehicle accidents near Dillingham.

ⁱ Does not include 2 bulls from an unspecified portion of Unit 17.

^j Does not include 3 bulls from an unspecified portion of Unit 17.

^k Does not include 1 bull from an unspecified portion of Unit 17.

^l Does not include 1 bull from an unspecified portion of Unit 17.

Table 9 Unit 17 moose hunter residency and success^a by permit hunt, 1992/93–2000/01

Regulatory Year	Successful				Unsuccessful				Total hunters
	Local Resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total(%)	
1992–93	43	7	0	50 (27)	122	11	0	133 (73)	183
1993–94	84	21	0	105 (39)	130	33	0	164 (61)	269 ^c
1994–95	106	29	0	135 (44)	128	45	0	175 (56)	310 ^d
1995–96	117	48	0	165 (42)	131	100	0	231 (58)	396
1996–97	117	60	0	177 (42)	157	92	0	249 (58)	426
1997–98	164	33	0	197 (37)	272	60	0	332 (63)	529
1998–99	183	37	0	220 (42)	251	54	0	305 (58)	525
1999-00	221	58	0	279 (46)	262	71	0	333 (54)	612
2000-01	144	45	0	189 (33)	304	82	0	386 (67)	575

^a Includes only permittees who reported hunting.

^b Unit 17 residents.

^c Includes 0 successful and 1 unsuccessful hunters of unknown residency.

^d Includes 0 successful and 2 unsuccessful hunters of unknown residency.

Table 10 Unit 17A reported moose harvest data by permit hunt, 1997/98–2000/01

Hunt No /Area	Regulatory Year	Permits issued ^a	Percent did not hunt	Percent unsuccessful hunters ^b	Percent successful hunters ^b	Bulls (%)	Cows (%)	Unk.	Total harvest
573	1997–98	44	11	62	38	15 (100)	0	0	15
	1998–99	48	10	77	23	10 (100)	0	0	10
	1999–00	57	28	76	24	10 (100)	0	0	10
	2000–01	56	13	80	20	10 (100)	0	0	10

^a Registration permits were valid for only Unit 17A.

^b Includes only those permittees reporting that they hunted.

Table 11 Unit 17B reported moose harvest data by permit hunt, 1992/93–2000/01

Hunt No /Area	Regulatory Year	Permits issued ^a	Percent did not hunt	Percent unsuccessful hunters ^b	Percent successful hunters ^b	Bulls (%)	Cows (%)	Unk.	Total harvest
983	1992–93	277	30	63	27	8(100)	0	0	8
583	1993–94	433	19	61	39	23 (100)	0	1	24
	1994–95	438	18	56	44	35 (100)	0	0	35
	1995–96	521	21	56	44	44 (100)	0	0	44
	1996–97	546	20	63	37	36 (100)	0	0	36
583/585	1997–98 ^c	629	25	63	37	41 (100)	0	0	41
	1998–99 ^c	634	25	69	31	29 (100)	0	0	29
	1999–00	749	24	53	47	48 (100)	0	0	48
	2000–01	685	23	61	39	61 (100)	0	0	61

^a Registration permits were valid for both Units 17B and 17C. Permit data are for both areas combined, harvest data are specific to Unit 17B.

^b Of those permittees that reported hunting in Unit 17B.

^c Includes permits issued and harvest for both fall (Aug.20–Sept15) and winter (Dec. 1–31) permit hunts.

Table 12 Unit 17C reported moose harvest data by permit hunt, 1992/93–2000/01

Hunt No /Area	Regulatory Year	Permits issued ^a	Percent did not hunt	Percent unsuccessful hunters ^b	Percent successful hunters ^b	Bulls (%)	Cows (%)	Unk.	Total harvest
983	1992–93	277 ^b	30	63	27	31 ^d (100)	0	3	34
583	1993–94	433	19	61	39	59 ^e (100)	1	0	60
	1994–95	438	18	56	44	65 ^f (100)	0	1	66
	1995–96	521	21	59	41	87 ^g (100)	0	0	87
	1996–97	546	20	54	46	89 ^h (99)	0	1	90
583/585	1997–98 ^c	629	25	60	40	105 ⁱ (100)	0	0	105
	1998–99 ^c	634	25	48	52	144 ^j (100)	0	0	144
	1999–00	749	24	49	51	169 ^k (100)	0	0	169
	2000–01	685	23	68	32	118 ^l (100)	0	0	118

^a Registration permits were valid for both Units 17B and 17C. Permit data are for both areas combined, harvest data are specific to Unit 17C.

^b Of those permittees who reported hunting in Unit 17C.

^c Includes permits issued and harvest for both fall (Aug.20-Sept15) and winter (Dec. 1-31) permit hunts.

^d Not included are 8 bulls from an unspecified portion of Unit 17.

^e Not included are 20 bulls from an unspecified portion of Unit 17 and 1 bull from Unit 17A.

^f Not included are 34 bulls from an unspecified portion of Unit 17.

^g Not included are 33 bulls from an unspecified portion of Unit 17 and 1 unknown sex.

^h Not included are 51 bulls from an unspecified portion of Unit 17.

ⁱ Not included are 36 bulls from an unspecified portion of Unit 17.

^j Not included are 37 bulls from an unspecified portion of Unit 17.

^k Not included are 52 bulls from an unspecified portion of Unit 17.

^l Not included are 51 bulls from an unspecified portion of Unit 17.

Table 13 Unit 17 reported moose harvest^a chronology percent by month, 1992/93–2000/01

Regulatory Year	Harvest periods									<i>n</i> ^b
	Aug 10-20	Aug 21-31	Sep 1-10	Sep 11-20	Sep 21-30	Dec 1-10	Dec 11-20	Dec 21-31	Unk.	
1992–93 ^c	0	3	44	41	0	2	2	4	3	212
1993–94 ^d	1	2	54	35	0	0	1	1	6	144
1994–95 ^d	1	3	47	37	3	1	2	3	5	161
1995–96 ^d	1	2	55	32	0	0	1	1	9	171
1996–97 ^d	1	2	63	27	0	1	0	2	6	196
1997–98 ^d	0	1	55	36	0	1	1	1	5	150
1998–99 ^d	0	2	60	35	0	0	0	0	2	169
1999-00	0	3	51	42	0	2	0	1	1	146
2000-01	0	0	55	10	0	0	0	0	4	184

^a Excludes permit hunt harvest.

^b Reported harvest

^c General season dates: Unit 17B (upstream) - Sep 1–20
Unit 17B (remainder) - Residents: Sep 1–20, Dec 1–31
Nonresidents: Sep 5–15
Unit 17C (Iowithla, etc.) - Residents: Sep 1–15
Unit 17C (remainder) - Residents: Sep 1–15, Dec 1–31

^d General season dates Unit 17B - Sep 1–15
Unit 17C - Residents: Sep 1–15

Table 14 Unit 17 reported moose harvest chronology for permit hunts, percent by month, 1992/93–2000/01

Regulatory Year	Harvest periods									<i>n</i> ^a
	Aug 10–20	Aug 21–31	Sep 1–10	Sep 11–20	Sep 21–30	Dec 1–10	Dec 11–20	Dec 21–31	Unk.	
1992–93 ^b	20	72	2	0	0	0	0	0	6	50
1993–94 ^c	9	40	19	10	2	3	6	5	8	105
1994–95 ^c	7	30	29	10	1	2	7	8	6	135
1995–96 ^c	15	33	26	14	1	2	1	4	6	165
1996–97 ^c	7	33	23	20	1	2	5	3	5	177
1997–98 ^d	6	35	16	21	0	2	4	11	5	197
1998–99 ^d	10	44	22	14	0	1	1	6	2	220
1999–00	13	44	16	13	0	1	4	4	6	279
2000–01	17	32	24	19	0	2	1	1	5	189

^a Reported harvest

^b Registration permits valid for Aug 20–31.

^c Registration permits valid for any bull, Aug 20–Sep 15 and Dec 1–31.

^d Registration permits valid for any bull; Unit 17A Aug. 20-Sep 15, Unit 17B and 17C Aug 20–Sep15 and Dec. 1–31.

Table 15 Unit 17 reported moose harvest^a percent by transport method, 1992/93–2000/01

Regulatory year	Percent of harvest								Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1992–93	64	0	29	0	2	0	1	3	212
1993–94	71	0	26	0	9	0	0	1	144
1994–95	71	0	22	0	2	0	1	3	161
1995–96	64	0	33	1	1	0	1	1	171
1996–97	68	0	29	0	2	0	1	1	196
1997–98	65	0	30	1	3	0	1	0	150
1998–99	67	0	32	0	1	1	0	1	169
1999-00	61	0	36	0	3	0	0	0	146
2000-01	75	0	23	0	0	0	0	2	184

^a Excludes permit hunt harvest.

Table 16 Unit 17 reported moose harvest by permit hunt, percent by transport method, 1992/93–2000/2001

Regulatory Year	Percent of harvest								Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1992–93	9	0	83	1	0	1	1	5	50
1993–94	15	0	73	0	6	0	4	3	105
1994–95	18	0	59	0	12	0	3	8	135
1995–96	25	0	68	0	4	0	1	2	165
1996–97	26	0	63	0	6	0	2	3	177
1997–98	8	1	73	0	16	0	1	2	197
1998–99	5	0	81	3	6	0	0	5	220
1999-00	11	0	74	1	9	0	2	2	279
2000-01	13	0	78	1	3	0	1	4	189